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Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
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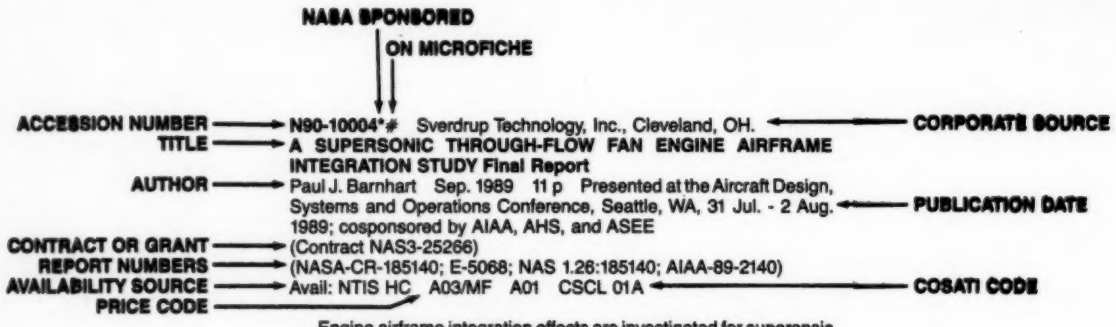
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ACCESSION NUMBER
N90-10004*# Sverdrup Technology, Inc., Cleveland, OH.
CORPORATE SOURCE
TITLE
A SUPERSONIC THROUGH-FLOW FAN ENGINE AIRFRAME INTEGRATION STUDY Final Report
AUTHOR
Paul J. Barnhart Sep. 1989 11 p Presented at the Aircraft Design, Systems and Operations Conference, Seattle, WA, 31 Jul. - 2 Aug. 1989; cosponsored by AIAA, AHS, and ASEE
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Engine airframe integration effects are investigated for superonsic through-flow fan engines installed on a Mach 3.20 supersonic cruise vehicle. Six different supersonic through-flow fan engine installations covering the effects of engine size, nacelle contour, nacelle placement, and approximate bypass plume effects are presented. The different supersonic through-flow fan installations are compared with a conventional turbine bypass engine configuration on the same basic airframe. The supersonic through-flow fan engine integrations are shown to be comparable to the turbine bypass engine configuration on the basis of installed nacelle wave drag. The supersonic through-flow fan engine airframe integrated vehicles have superior aerodynamic performance on the basis of maximum lift-to-drag ratio than the turbine bypass engine installation over the entire operating Mach number range from 1.10 to 3.20. When approximate bypass plume modeling is included, the supersonic through-flow fan engine configuration shows even larger improvements over the turbine bypass engine configuration. Author

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Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

N90-24225# Technische Univ., Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt.
TEST AND MEASUREMENT TECHNIQUE IN HYPERSONICS [VERSUCHS- UND MESSTECHNIK IN HYPERSCHALL]
J. Szodruch, ed. and W. Nitsche, ed. Jun. 1989 150 p In ENGLISH and GERMAN Congress held in Goettingen, Fed. Republic of Germany, 2-3 Mar. 1989 Original contains color illustrations LIMITED REPRODUCIBILITY: More than 20% of this document may be affected by color photographs
(ILR-Mitt-225(1989); ETN-90-96480) Avail: NTIS HC A07/MF A01

Hypersonics often appear in current projects such as Hermes and Sanger. The partners in the 1989 Goettingen congress agreed that the status of the technique does not enable economical developments of transporters. Topics include: a wind tunnel for the investigation of compressible flows until M equals 6; a gun-tunnel for flow mechanics; high enthalpy hypersonic wind tunnel; LARVE mission; hypersonic vacuum wind tunnels; flow field measurements in the retaining point area of a half spheric cylinder by thin hypersonic flow with electron radiation; short-time force measuring system for shock wave channels; calculation of accuracy for force and moment measurements in radial flow field of hypersonic conic nozzles; and infrared thermography in hypersonics. For individual titles, see N90-24226 though N90-24235.

N90-24226# Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer Thermo- und Fluiddynamik.
THE WIND TUNNEL OF THE RUHR UNIVERSITY, BOCHUM, FEDERAL REPUBLIC OF GERMANY FOR EXAMINATION OF COMPRESSIBLE STREAMS UNTIL M=6 [DER WINDKANAL DER RUHR-UNIVERSITAET BOCHUM ZUR UNTERSUCHUNG VON STROEMUNGEN BIS MA=6] **c09**
A. Schmuecker, K. Gersten, and H.-D. Papenfuss *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 1-6 In GERMAN (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

To realize this wind tunnel simulation a blow-down channel was used with a diffusor system to directly conduct the blow volume gas into the open air. The temperature ratio at wall and boundary must be of 5 up to 8. For a fixed Mach number, the Reynolds number only depends on the rest temperature which must be as low as possible to avoid air condensation and reduce the dynamic viscosity. ESA

N90-24227# Technische Univ., Brunswick (Germany, F.R.).
THE GUN TUNNEL OF THE BRUNSWICK INSTITUTE FOR FLUID MECHANICS: CURRENT DEVELOPMENT STATUS [DER GUN-TUNNEL DES INSTITUTS FUER STROEMUNGSMECHANIK DER TU BRAUNSCHWEIG: DERZEITIGER AUSBAUZUSTAND] **c09**
D. Hummel and H. Petzel *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 7-40 In GERMAN (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

The power consumption of the test installation and the technical problems are discussed by means of simple measurement examples. The test apparatus consisted of a high pressure reservoir, a pipe for conditioning of the test gas mass and the nozzle related to the measurement line, linked above the diffusor with the vacuum box. Pressures, heat transfer, forces and moments are measured. The rest temperature is evaluated by the shock reflexion process. The study parameters are the Knudsen, Mach and Reynolds numbers. ESA

N90-24228# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France).
HIGH ENTHALPY HYPERSONIC WIND TUNNEL F4: GENERAL DESCRIPTION AND ASSOCIATED INSTRUMENTATION **c09**
J. P. Chevallier, J. Christophe, and A. Girard *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 41-57 (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

The previous short arc heated facilities used by ONERA are briefly reviewed and the new hot shot wind tunnel F4, currently under construction, is presented. The running time varies in the interval 20 to 100 ms. The expected reservoir pressure will reach 2000 bar and the expected maximum value of the reduced enthalpy will be 200. The associated instrumentation includes a six-component balance compensated for inertial effects, a Schlieren device, with mirrors included in the vacuum chamber. The real gas effects are especially studied. This includes the electron beam fluorescence technique. The locally measured parameters are flowfield density, flow velocity and rotational and vibrational temperature of nitrogen. Visualization by holographic interferometry, high speed infrared thermography, coherent antistokes Raman scattering are other techniques for NO concentration measurements. ESA

N90-24229# National Aerospace Lab., Amsterdam (Netherlands).
MISSION OF LARVE **c34**
H. Hagmeijer and K. J. Sudmeijer *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 58-72 Sponsored by Netherlands Agency for Aerospace Programs (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

With relation to the main problems in hypersonic aerothermodynamic and aerodynamic research are reviewed. To develop useful design tools for re-entry vehicles, a balanced combination of computational fluid dynamics, wind tunnel experiments, and free flight tests is needed. A flight test facility can be simple and cost effective if flown as piggyback in the second stage of Ariane 4. It is shown that high-enthalpy hypersonic wind tunnels are unable to reproduce the main simulation parameters of hypersonic flow simultaneously. These ground-based facilities provide predissociated flow immediately upstream of test models due to the nozzle-relaxation effects. ESA

N90-24230# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).
THE ARC-HOT WIND TUNNEL [DER LICHTBOGENBEHEIZTE WINDKANAL (LBK) DER DLR] **c09**
Knud Kindler *In* Technische Univ. Berlin, Test and Measurement

Technique in Hypersonics Jun. 1989 p 73-92 In GERMAN (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

Stream fields in which chemical reactions arise by stream mechanical processes, are evaluated by means of the characteristic stream and reaction times. The first one is defined by characteristic lengths and flight velocity, the second one depends on the number and method of interaction of the gas particles. The wind tunnel used allows the examination of high enthalpy flows to estimate the influence of the surface wall materials on the gas reactions or the chemical reaction processes in the gas area near to the wall. ESA

N90-24231# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.).
THE HYPERSONIC VACUUM WIND TUNNELS: STATUS, RESEARCH, AND NECESSARY DEVELOPMENTS [DIE HYPERSONISCHEN VAKUUMWINDKANAELE: STATUS, ANFORDERUNGEN UND NOTWENDIGE WEITERENTWICKLUNGEN] **c09**
G. Koppenwallner *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 93-111 In GERMAN (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

The tunnel system is of continuous type consisting of two different test sections which are run from a common pressure and vacuum system. Both test sections can be operated either with air or nitrogen. For each gas a separate high pressure reservoir and compression system is available. The gas can be heated in every test section either with a Kanthal resistance heater, where air is used as test gas, or with a graphite resistance heater, when nitrogen is used as test gas. Both test sections are pumped by a roots blower pumping system having a constant pumping speed of 120,000 cubic meters per hour in a pressure range of 0.001 to 3 Torr. ESA

N90-24232# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.).
STREAM FIELD MEASUREMENTS OF A HALF SPHERIC CYLINDER BY THIN HYPERSONIC STREAM WITH THE ELECTRON RADIATION TECHNIQUE [STROEMUNGSFELDMESSUNGEN IM STAUPUNKTBEREICH EINES HALBKUGELZYLINDERS BEI VERDUENNTER HYPERSCHALLSTROEMUNG MIT HILFE DER ELEKTRONENSTRAHLTECHNIK] **c02**
K. A. Buetefisch *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 112-123 In GERMAN (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

The influence of the wall conditions on the flow field around blunt bodies by thin hypersonic flow of polyatomic gases is described. The influence of the oscillation relaxation and the catalytic effect of a solid wall are examined. Experiments are carried out to determine the rotation temperature, density and velocity curves, with nitrogen as test gas. The half cylinder used was made of a thin wall galvanoplastic body made of nickel. A good agreement with the theoretical values is found, apart from the oscillation temperature which is lower near to the wall. ESA

N90-24233# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Unternehmensbereich Transport- und Verkehrsflugzeuge.
SHORT TIME FORCE AND MOMENT MEASUREMENT SYSTEM FOR SHOCK TUBES (SFS) FOR MEASURING TIMES LESS THAN 10 ms **c09**
Josef Mertens and Klaus Koenig *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 124-144 In ENGLISH and GERMAN (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

Usual wind tunnel balances measure 6 independent balance deformations for evaluation of the resulting aerodynamic air-forces and moments. Modal analysis and optimization of the model are made by finite element calculations. The modal characteristics of the model are checked by vibration tests and improvement of the finite element modelization. The representative points for acceleration measurement of the modal motion are selected for the calibration. The influence matrices are calculated taking into account the calibration tests. The transient loads are obtained by acceleration measurement and calculated. ESA

N90-24234# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.). Abt. verduennte/reale Gase.
CALCULATION OF CORRECTION TERMS FOR FORCES AND MOMENT MEASUREMENTS IN RADIAL FLOW FIELD OF HYPERSONIC SPHERIC NOZZLES [BERECHNUNG VON KORREKTURGROESSEN FUER KRAFT- UND MOMENTENMESSUNGEN IM RADIALSTROEMUNGSFELD HYPERSONISCHER KEGELDUESEN] **c02**
Thomas Poertner *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 145-154 In GERMAN (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

The radial hypersonic flow field arising behind spheric nozzles is described by the simplified universal plume model. The differences between radial and parallel flow is estimated by the Newton method. The calculation grid must be sufficiently fine to correctly describe the spheric geometry and the effects of length gradients of the flow field. The radial flow field is modelized by a virtual source point which is the origin of the stream lines; the density depends quadratically on the distance to the source. ESA

N90-24235# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Hauptabt. Windkanaele.
INFRARED THERMOGRAPHY AT HYPERSONIC CHANNEL H2K [EINSATZ DER INFRAROT-THERMOGRAPHIE AM HYPERSCHALLKANAL H2K DER DLR KOELN] **c09**
A. Henckels and F. Maurer *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 155-168 In GERMAN (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

A modern infrared camera system and the digital image processing allow to obtain the surface temperature of the wind tunnel model for the total test time. By representation of the isotherm lines on the model surface a qualitative idea of the areas of low and high heat transfers is obtained. The quantitative estimation of the time dependent heat transfer of the flow in the model surface is made by the thin walls technique. Examples from the area of flow around blunt bodies or near to the boundary layer show the particular importance of the thermography in the processing of the aerothermodynamic problems in the wind tunnel technique. ESA

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N90-24236 Nielsen Engineering and Research, Inc., Mountain View, CA.
MISSILE AERODYNAMICS
Jack Norman Nielsen 1988 462 p
(ISBN-0-9620629-0-1; LC-88-15223) Copyright Avail: Issuing Activity

A rational and unified account of the principal subjects of missile aerodynamics and adequate mathematical treatment of the subjects for use in design is presented. Emphasis is placed on supersonic speeds, although much material applicable to subsonic speeds is included. The backbone of missile aerodynamics, slender body

theory, is addressed and an orderly building up of a missile from its component parts, the body alone, the wing panels, the tail, and the control surfaces is presented. Flow fields, wing-body and wing-body-tail combinations are discussed. Finally, aerodynamic drag and stability are addressed. M.G.

N90-24237*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AERODYNAMIC PERFORMANCE OF A 0.27-SCALE MODEL OF AN AH-64 HELICOPTER WITH BASELINE AND ALTERNATE ROTOR BLADE SETS
Henry L. Kelley Washington Jul. 1990 24 p
(DA Proj. 1L1-62211-AH-7-AA)
(NASA-TM-4201; L-16725; NAS 1.15:4201;
AVSCOM-TM-90-B-015) Avail: NTIS HC A03/MF A01 CSCL 01A

Performance of a 27 percent scale model rotor designed for the AH-64 helicopter (alternate rotor) was measured in hover and forward flight and compared against and AH-64 baseline rotor model. Thrust, rotor tip Mach number, advance ratio, and ground proximity were varied. In hover, at a nominal thrust coefficient of 0.0064, the power savings was about 6.4 percent for the alternate rotor compared to the baseline. The corresponding thrust increase at this condition was approx. 4.5 percent which represents an equivalent full scale increase in lift capability of about 660 lbs. Comparable results were noted in forward flight except for the high thrust, high speed cases investigated where the baseline rotor was slightly superior. Reduced performance at the higher thrusts and speeds was likely due to Reynolds number effects and blade elasticity differences. Author

N90-24238*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
STATIC WIND-TUNNEL AND RADIO-CONTROLLED FLIGHT TEST INVESTIGATION OF A REMOTELY PILOTED VEHICLE HAVING A DELTA WING PLANFORM
Long P. Yip, David J. Fratello, David B. Robelen, and George M. Makowiec (Vigyan Research Associates, Inc., Hampton, VA.) Washington 1990 35 p
(NASA-TM-4200; L-16742; NAS 1.15:4200) Avail: NTIS HC A03/MF A01 CSCL 01A

At the request of the United States Marine Corps, an exploratory wind-tunnel and flight test investigation was conducted by the Flight Dynamics Branch at the NASA Langley Research Center to improve the stability, controllability, and general flight characteristics of the Marine Corps Exdrone RPV (Remotely Piloted Vehicle) configuration. Static wind tunnel tests were conducted in the Langley 12 foot Low Speed Wind Tunnel to identify and improve the stability and control characteristics of the vehicle. The wind tunnel test resulted in several configuration modifications which included increased elevator size, increased vertical tail size and tail moment arm, increased rudder size and aileron size, the addition of vertical wing tip fins, and the addition of leading-edge droops on the outboard wing panel to improve stall departure resistance. Flight tests of the modified configuration were conducted at the NASA Plum Tree Test Site to provide a qualitative evaluation of the flight characteristics of the modified configuration. Author

N90-24239*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AERODYNAMIC CHARACTERISTICS OF TWO ROTORCRAFT AIRFOILS DESIGNED FOR APPLICATION TO THE INBOARD REGION OF A MAIN ROTOR BLADE
Kevin W. Noonan (Army Aerostructures Directorate, Hampton, VA.) Washington Jul. 1990 89 p
(DA Proj. 1L1-62211-A-47-AA)
(NASA-TP-3009; L-16737; NAS 1.60:3009;
AVSCOM-TR-90-B-005) Avail: NTIS HC A05/MF A01 CSCL 01A

A wind tunnel investigation was conducted to determine the 2-D aerodynamic characteristics of two new rotorcraft airfoils designed especially for application to the inboard region of a helicopter main rotor blade. The two new airfoils, the RC(4)-10 and RC(5)-10, and a baseline airfoil, the VR-7, were all studied in the Langley Transonic Tunnel at Mach nos. from about 0.34 to 0.84 and at Reynolds nos. from about 4.7 to 9.3 x 10 (exp 6). The VR-7 airfoil had a trailing edge tab which is deflected upwards 4.6 degs. In addition, the RC(4)-10 airfoil was studied in the Langley Low Turbulence Pressure Tunnel at Mach nos. from 0.10 to 0.44 and at Reynolds nos. from 1.4 to 5.4 x 10 (exp 6) respectively. Some comparisons were made of the experimental data for the new airfoils and the predictions of two different theories. The results of this study indicates that both of the new airfoils offer advantages over the baseline airfoil. These advantages are discussed. Author

N90-24240 Manchester Univ. (England).
THE COMPUTATION OF TURBULENT THIN SHEAR FLOWS ASSOCIATED WITH FLOW AROUND MULTIELEMENT AEROFOILS Ph.D. Thesis
Zoubir Nemouchi 1988 328 p
Avail: Univ. Microfilms Order No. BRD-87219

A computational procedure for the computation of two-dimensional incompressible thin shear associated with the flow around multi-element aerofoils was developed and assessed. The performance of three two-equation turbulence models was examined: the K-epsilon eddy-viscosity model (EVM) and two versions of the algebraic stress transport model (ASM). These were employed in conjunction with an existing parabolic solving procedure and a semi-elliptic version. The discretization of the partial differential equations in the numerical procedure is based on the fully-conservative finite-volume approach. The test cases considered include both straight and curved, free and wall-bounded, developing and self-similar, isolated and merging shear layers in zero and non-zero pressure gradients. The ASMs provided satisfactory predictions for a wider range of flows than the K-epsilon model. For example, the ASMs gave a more realistic prediction of the sensitivity of the turbulence structure to streamline curvature than the K-epsilon EVM. The last phase of the research was directed towards the refinement of, first the ASM but subsequently and more successfully, a differential stress model (DSM). The modified versions of both the ASM and DSM were applied to the computation of two free shear flows. A DSM employing a new model for the pressure-strain process and a new formulation for the turbulent kinetic energy dissipation rate gave significantly improved predictions of the weak-shear plane asymptotic wake. At the same time, the satisfactory prediction of the self-preserving plane jet in stagnant surroundings, using the new version, is preserved. Dissert. Abstr.

N90-24241 Pennsylvania State Univ., University Park.
THE INTERACTION OF A SUPERSONIC STREAMWISE VORTEX AND A NORMAL SHOCK WAVE Ph.D. Thesis
Omar M. Metwally 1989 268 p
Avail: Univ. Microfilms Order No. DA9007895

A detailed experimental investigation on the generation of a turbulent, supersonic streamwise vortex subsequent interactions with a normal shock wave are presented. The vortex is generated in the supersonic wind tunnel inviscid freestream of Mach 3 using a streamlined, axisymmetric strut-mounted swirl injector. Flow-angularity probe measurements show that the supersonic vortex core, having a streamwise Mach number of 3.0 and transonic tangential Mach numbers up to 0.9, resembles the incompressible vortex in its three-layered structure: an innermost viscous layer with solid body rotation, a logarithmic middle layer and an outer inviscid layer. Total temperature probe surveys show an isoenergetic vortical flow condition. The vortex is then passed through a normal shock created by mismatching static pressure of the vortical flow with that of the Mach 2 freestream. The resulting interaction, primarily observed by way of non-intrusive optical flow diagnostics, is shown to be sensitive to the initial swirl rate of the vortex. Passing a low-swirl vortex through the shock results in a weak interaction which resembles the inviscid, non-swirling flow case. For otherwise similar flow conditions, increasing the initial swirl rate of the vortex resulting in a strong, highly unsteady interaction as the shock distends upstream in a cone-like behavior

and recompression shock forms downstream. Flow-angularity probe surveys show that the flow well downstream of both interactions is vortical again with a streamwise Mach number of 1.7. Two other vortex Mach numbers of 2.2 and 3.5 are covered for different initial swirl rates up to 0.4. On the basis of the current observations, a physical model that postulates the effect of the vortex breakdown phenomenon on the interaction flow pattern is presented. Navier-Stokes computations utilizing the present initial flow conditions partially support the physical model is predicting several key features of the observed strong interaction flow pattern.
Dissert. Abstr.

N90-24242*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
SUBSONIC STING INTERFERENCE ON THE AERODYNAMIC CHARACTERISTICS OF A FAMILY OF SLANTED-BASE OGIVE-CYLINDERS
Colin P. Britcher, Charles W. Alcorn, and W. Allen Kilgore Washington Jun. 1990 75 p
(Grant NAG1-716)
(NASA-CR-4299; NAS 1.26:4299) Avail: NTIS HC A04/MF A01 CSCL 01A

Support interference free drag, lift, and pitching moment measurements on a range of slanted base ogive cylinders were made using the NASA Langley 13 inch magnetic suspension and balance system. Typical test Mach numbers were in the range 0.04 to 0.2. Drag results are shown to be in broad agreement with previous tests with this configuration. Measurements were repeated with a dummy sting support installed in the wind tunnel. Significant support interferences were found at all test conditions and are quantified. Further comparison is made between interference free base pressures, obtained using remote telemetry, and sting cavity pressures.
Author

N90-24243 George Washington Univ., Washington, DC.
ROTARY-JET THRUST AUGMENTOR WITH JET-FLAPPED BLADES Ph.D. Thesis
Stephane Jean Cordier 1989 190 p
Avail: Univ. Microfilms Order No. DA9010239

The concepts and the mechanisms of thrust augmentation are analyzed. The theoretical performance of different types of thrust augmentors is discussed with an emphasis on the Rotary-Jet ejector. The application of thrust augmentors to STOVL aircrafts and the merits of the ejector in this application are discussed where the theoretical performance of the Rotary-Jet is shown to be particularly attractive. Recent experimental work on the Rotary-Jet is analyzed and several factors adversely affecting performance are identified and discussed. To address these problems a new configuration is proposed where the rotor is fitted with blades, allowing better control of the primary/secondary interaction. The jet sheet exiting at the trailing edge of the foil forms a jet flap. A two-dimensional analysis of the aerodynamics around a jet-flapped airfoil is performed for the first time using a fluid finite element code. In previous models the presence of the pressure gradient across the jet sheet is an assumption, its presence is predicted by the present method. This method is applied to the geometry of blade model 10. An original three-dimensional model of the self-driven, jet-flapped bladed rotor is presented which, given set geometrical parameters and operating conditions, solves at each section for the jet and blade angle and calculates the rotor thrust augmentation. The results of parametric runs identify favorable design trends which are applied to the design of prototype test models. An experimental test program was performed. Flow visualization and local flow velocity and pressure measurements were used to identify favorable jet sheet characteristics. Seven blade models were tested in a parametric study. Rotor thrust augmentation without shroud is on the order of 1.0 with a maximum of 1.14. Within the range of parameters tested, optimum spin and flap angles were identified and a maximum thrust augmentation of 2.18 was reached. Tests with increasing exit to primary area ratio shows a monotonic increase in performance as opposed to the non-bladed rotary-jet, which reached a peak performance at a certain area ratio.
Dissert. Abstr.

N90-24244 Duke Univ., Durham, NC.
REDUCED ORDER MODELS FOR NONLINEAR AERODYNAMICS Ph.D. Thesis
Aparajit Jagannath Mahajan 1989 146 p
Avail: Univ. Microfilms Order No. DA9010366

A finite difference, time marching Navier-Stokes solver with many degrees of freedom is validated for unsteady airfoil motion by comparing with classical incompressible potential flow results. Then two types of reduced order models are presented for predicting unsteady aerodynamic forces on arbitrary airfoils under stalled and unstalled conditions. First, a semi-empirical model is described to model aerodynamic forces by second order ordinary differential equations for lift and moment with airfoil motion as the input. This model is simultaneously integrated with structural dynamics equations to determine flutter characteristics for a two degrees-of-freedom system. Results for a number of cases are presented to demonstrate the suitability of this model to predict flutter. Comparison is made to the flutter characteristics determined by the Navier-Stokes solver and also the classical incompressible potential flow theory. Second, a modified Lanczos procedure is developed for computing eigenvalues and eigenvectors associated with small perturbation analysis of a finite difference representation of the Navier-Stokes equations for flows over airfoils. A separate procedure, based on lopsided iteration, is also used to determine the eigensystem. The results from these two procedures are compared. A reduced order model using Lanczos Coordinates transformation is then developed. The results for test cases and flows over airfoils are also presented. Then a method is proposed to determine directly the amount of artificial viscosity needed for stability using this eigenvalue analysis. The movement of the eigenvalue constellation with respect to the amount of artificial viscosity is studied. The stability boundaries as a function of the amount of artificial viscosity from both the eigenvalue analysis and the time marching scheme are also presented.
Dissert. Abstr.

N90-24245*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
CONCERNING THE INTERACTION OF NON-STATIONARY CROSS-FLOW VORTICES IN A THREE-DIMENSIONAL BOUNDARY LAYER Final Report
Andrew P. Bassom and Philip Hall (Exeter Univ., England) May 1990 37 p Submitted for publication
(Contracts NAS1-18605; SERC-XG-10176)
(NASA-CR-182037; NAS 1.26:182037; ICASE-90-32) Avail: NTIS HC A03/MF A01 CSCL 01A

Recently there has been much work devoted to considering some of the many and varied interaction mechanisms which may be operative in three-dimensional boundary layer flows. This paper is concerned with resonant triads of crossflow vortices. The effects of interactions upon resonant triads is examined where each member of the triad has the property of being linearly neutrally stable so that the importance of the interplay between modes can be relatively easily assessed. Modes within the boundary layer flow above a rotating disc are investigated because of the similarity between this disc flow and many important practical flows and, secondly, because the selected flow is an exact solution of the Navier-Stokes equations which makes its theoretical analysis especially attractive. It is demonstrated that the desired triads of linearly neutrally stable modes can exist within the chosen boundary layer flow. Evolution equations are obtained to describe the development of the amplitudes of these modes once the interaction mechanism is accounted for. It is found that the coefficients of the interaction terms within the evolution equations are, in general, given by quite intricate expressions although some elementary numerical work shows that the evaluation of these coefficients is practicable. The basis of the work lends itself to generalization to more complicated boundary layers, and effects of detuning or non-parallelism could be provided for within the asymptotic framework.
Author

N90-24246*# Lockheed Engineering and Sciences Co., Hampton, VA.
UNSTEADY POTENTIAL FLOW PAST A PROPELLER BLADE SECTION Final Report
M. A. Takallu Washington NASA Jul. 1990 28 p
(Contract NAS1-19000)
(NASA-CR-4307; NAS 1.26:4307) Avail: NTIS HC A03/MF A01 CSCL 01A

An analytical study was conducted to predict the effect of an oscillating stream on the time dependent sectional pressure and lift coefficients of a model propeller blade. The assumption is that as the blade sections encounter a wake, the actual angles of attack vary in a sinusoidal manner through the wake, thus each blade is exposed to an unsteady stream oscillating about a mean value at a certain reduced frequency. On the other hand, an isolated propeller at some angle of attack can experience periodic changes in the value of the flow angle causing unsteady loads on the blades. Such a flow condition requires the inclusion of new expressions in the formulation of the unsteady potential flow around the blade sections. These expressions account for time variation of angle of attack and total shed vortices in the wake of each airfoil section. It was found that the final expressions for the unsteady pressure distribution on each blade section are periodic and that the unsteady circulation and lift coefficients exhibit a hysteresis loop. Author

N90-24247# Centro Italiano Ricerche Aerospaziali, Naples.
CODE ETF-3D. EULER TRANSONIC FLOW: THEORETICAL MANUAL
S. Borrelli 22 Feb. 1989 41 p In ITALIAN; Title in ENGLISH
(DLC/FLU-INT-TN-005; ETN-90-96557) Avail: NTIS HC A03/MF A01

The theoretical manual of a computer program developed to study compressible non viscous velocity fields is presented. The described procedure is robust and efficient and is devoted to solving three dimensional transonic aerodynamic engineering problems. Flow analysis around wing profiles is a typical application. The local Mach number must be below 1.8 to obtain solutions of good quality. ESA

N90-24248# Centro Italiano Ricerche Aerospaziali, Naples.
CODE ETF-3D. EULER TRANSONIC FLOW: VALIDATION MANUAL
S. Borrelli 23 Feb. 1990 111 p In ITALIAN; Title in ENGLISH
(DLC/FLU-INT-TN-007; ETN-90-96564) Avail: NTIS HC A06/MF A01

The validation manual of a computer program developed to study compressible non viscous velocity fields is presented. The described procedure is robust and efficient and is devoted to solving three dimensional transonic aerodynamic engineering problems. Flow analysis around wing profiles is a typical application. The local Mach number must be below 1.8 to obtain solutions of a good quality. The validation is carried out using an M6 Onera wing profile at Mach number 0.84 and 0.92 and the results are compared with those of accepted computation codes including Onera/Matra, Dornier/Jameson, FFA/Rizzi and MBB/Eberle. ESA

N90-24249# Scientific Research and Technology, Inc., Hampton, VA.
LOW-DENSITY FLOW EFFECTS FOR HYPERVELOCITY VEHICLES, PHASE 2 Final Report, Jan. 1988 - Dec. 1989
Roop M. Gupta and Sudheer N. Nayani (Vigyan Research Associates, Inc., Hampton, VA.) 2 Mar. 1990 96 p
(Contract F33615-87-C-3020; AF Proj. 3005)
(AD-A221034; WRDC-TR-90-3007) Avail: NTIS HC A05/MF A01 CSCL 20/4

Detailed flowfield results were obtained for sphere-cone shaped bodies at various angles of attack with a 3D nonequilibrium viscous-shock-layer (VSL) code. Recently obtained surface and shock-slip boundary conditions are implemented to account for the low-density effects. These boundary conditions may also be employed with the Navier-Stokes equations with or without a shock-fitting solution technique. A method is suggested for obtaining the input shock shape for the 3D nonequilibrium viscous flow. This approach gives a superior convergence of results, especially under the low-density flow conditions and makes the VSL method self-starting. The analytic algebraic grid implemented with the equations does not add any numerical dissipation. Obtained results show the effect of low density on the surrounding flowfield and surface quantities for a hypervelocity vehicle. Good agreement is obtained with the available numerical results (including the Direct Simulation Monte-Carlo predictions) and experimental data for the low-density flight conditions. GRA

N90-24250# Douglas Aircraft Co., Inc., Long Beach, CA.
AN INTERACTIVE BOUNDARY-LAYER METHOD FOR UNSTEADY AIRFOIL FLOWS. PART 1: QUASI-STEADY-STATE MODEL Final Technical Report, 1 Jan. 1988 - 31 Dec. 1989
Tuncer Cebeci and Hong-Ming Jang (California State Univ., Long Beach.) Feb. 1990 29 p
(Contract F49620-88-C-0020; AF Proj. 2307)
(AD-A221220; MDC-K4856; AFOSR-90-0404TR) Avail: NTIS HC A03/MF A01 CSCL 01/1

An interactive boundary-layer method previously developed and tested for steady flows is used here in a quasi-steady manner to examine the evolution of the flow behavior of airfoils subject to harmonic oscillation and ramp-type motions. The calculations encompass the airfoil and wake flows at angles of attack which lead to separation. The results quantify the effects of the viscous boundary layer and wake on the variation of lift coefficient with angle of attack and reduced frequency. These effects are shown to be large at angles of attack which involve boundary-layer separation. GRA

N90-24251# Naval Surface Warfare Center, Silver Spring, MD.
WIND TUNNEL TESTS OF A 20-GORE DISK-GAP-BAND PARACHUTE Final Report, FY 1989 - FY 1990
William P. Ludtke 28 May 1989 64 p
(AD-A221326; NSWC/TR-89-180) Avail: NTIS HC A04/MF A01 CSCL 01/3

This report documents wind tunnel tests of a series of 20 gore Disk-Gap-Band parachutes to determine the effects of gap length, band billow, and cloth air permeability on the parachute aerodynamic characteristics. Measurements for the steady-state drag-force, opening shock force, oscillation stability, and inflation stability were made of the various configurations and are presented in tabular and graphical format. GRA

N90-24252*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ON THE INSTABILITY OF HYPERSONIC FLOW PAST A FLAT PLATE Final Report
Nicholas Blackaby, Stephen Cowley, and Philip Hall (Exeter Univ., England) May 1990 53 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-182051; NAS 1.26:182051; ICASE-90-40) Avail: NTIS HC A04/MF A01 CSCL 01A

The instability of hypersonic boundary-layer flows over flat plates is considered. The viscosity of the fluid is taken to be governed by Sutherland's law, which gives a much more accurate representation of the temperature dependence of fluid viscosity at hypersonic speeds than Chapman's approximate linear law; although at lower speeds the temperature variation of the mean state is less pronounced so that the Chapman law can be used with some confidence. Attention is focussed on the so-called (vorticity) mode of instability of the viscous hypersonic boundary layer. This is thought to be the fastest growing inviscid disturbance at hypersonic speeds; it is also believed to have an asymptotically larger growth rate than any viscous or centrifugal instability. As a starting point the instability of the hypersonic boundary layer which exists far downstream from the leading edge of the plate is investigated. In this regime the shock that is attached to the leading edge of the plate plays no role, so that the basic boundary layer is non-interactive. It is shown that the vorticity mode of instability of this flow operates on a significantly different lengthscale than

that obtained if a Chapman viscosity law is assumed. In particular, it is found that the growth rate predicted by a linear viscosity law overestimates the size of the growth rate by O(M(exp 2). Next, the development of the vorticity mode as the wavenumber decreases is described, and it is shown that acoustic modes emerge when the wavenumber has decreased from it's O(1) initial value to O(M (exp -3/2). Finally, the inviscid instability of the boundary layer near the leading edge in the interaction zone is discussed and particular attention is focussed on the strong interaction region which occurs sufficiently close to the leading edge. It is found that the vorticity mode in this regime is again unstable, and that it is concentrated in the transition layer at the edge of the boundary layer where the temperature adjusts from its large, O(M(exp 2), value in the viscous boundary layer, to its O(1) free stream value. The existence of the shock indirectly, but significantly, influences the instability problem by modifying the basic flow structure in this layer. Author

N90-24253# Technische Univ., Brunswick (Germany, F.R.). Fakultaet fuer Maschinenbau und Elektrotechnik.
TESTS FOR INTEGRATING MEASUREMENT OF GAS PRESSURES IN FLIGHT PROPELLERS Ph.D. Thesis [VERSUCHE ZUR INTEGRIERENDEN MESSUNG VON GASDRUECKEN IN FLUGTRIEBWERKEN]
Gerardo Walle 1989 217 p In GERMAN
(ETN-90-96498) Avail: NTIS HC A10/MF A02

The possibility of carrying out integrated pressure measurements with light wave conductors is discussed. An intensity modulated process is chosen in which the measured value changes the weakening of the light in the conduction by curvature of the fiber. The physical measurement principle was experimentally and theoretically analyzed at a fiber deformation unity in which a firmly fixed fiber section is mechanically weakened. The integral signal depiction of a measurement is examined for the mean value along the fiber, by means of the alignment of fiber deformation unities, which do not influence one another mechanically. The principle of the integrating measurement by means of amplitude modulation of the light in a mechanically distorted fiber is examined and the simulation of a practical utilization is evaluated. ESA

N90-24254# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.). Abt. Instationaere Aerodynamik.
A TIME-MARCHING METHOD TO CALCULATE UNSTEADY AIRLOADS ON THREE-DIMENSIONAL WINGS. PART 1: LINEARIZED FORMULATION
Luis Pablo Ruiz-Calavera Aug. 1989 54 p
(DLR-FB-89-58; ISSN-0171-1342; ETN-90-97008) Avail: NTIS HC A04/MF A01; DLR, VB-PL-DO, Postfach 40 60 58, 5000 Cologne, Fed. Republic of Germany, 23.50 deutsche marks

A linearized time-marching method to calculate unsteady airloads on three-dimensional wings arbitrarily moving in an incompressible potential flow is presented. A panel method with constant doublet panels on the wing and linearly varying doublet panels on the wake is used. The method is described in detail and some comparisons with analytical solutions and other numerical methods are presented. ESA

N90-24255# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.). Abt. fuer Instationaere Aerodynamik.
A TIME-MARCHING METHOD FOR CALCULATING UNSTEADY AIRLOADS ON THREE-DIMENTIONAL WINGS. PART 2: FULL-POTENTIAL FORMULATION
Luis Pablo Ruiz-Calavera Aug. 1989 68 p
(DLR-FB-89-59; ISSN-0171-1342; ETN-90-97009) Avail: NTIS HC A04/MF A01; DLR, VB-PL-DO, Postfach 40 60 58, 5000 Cologne, Fed. Republic of Germany, 28.50 deutsche marks

A time-marching method to calculate unsteady airloads on the three-dimensional wings arbitrarily moving in an incompressible potential flow is presented. A panel method with constant source and doublet panels on the wing and linearly varying doublet panels on the wake is used. The method allows nonlinear influences, such as those due to thickness, static angle of attack, amplitude of oscillation and position of the wake to be taken into account. ESA

N90-24256# Midwest Research Inst., Golden, CO.
AERODYNAMIC PRESSURE MEASUREMENTS ON A ROTATING WIND TURBINE BLADE
C. P. Butterfield, M. D. Jenks, D. A. Simms, and W. P. Musial May 1990 10 p Presented at the 36th Instrument Society of America International Instrumentation Symposium, Denver, CO, 7-10 May 1990
(Contract DE-AC02-83CH-10093)
(DE90-000327; SERI/TP-257-3695; CONF-900599-6) Avail: NTIS HC A02/MF A01

A microprocessor-controlled measurement system was designed and built to make accurate measurements of low pressures on a rotating wind turbine blade. This Pressure System Controller (PSC) is capable of simultaneously operating four pressure scanners (128 channels total) while rotating on a wind turbine blade. Calibrations and purge sequences are performed automatically on all 128 channels while the turbine is rotating. Data are fed to a Pulse Code Modulation (PCM) data-acquisition system and recorded on magnetic tape for later processing. Accurate measurements were made down to pressures of 11 microbars (0.00018 psi) for low Reynolds Number tests. These rotating blade pressure measurements are used to compare with wind tunnel data to see how blade rotation alters airfoil performance. A description of the test setup and instrumentation design is given along with examples results. Recommendations for future work and changes in the design approach are also discussed. DOE

N90-24232# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.).
STREAM FIELD MEASUREMENTS OF A HALF SPHERIC CYLINDER BY THIN HYPERSONIC STREAM WITH THE ELECTRON RADIATION TECHNIQUE [STROEMUNGSFELDMESSUNGEN IM STAUPUNKTBEREICH EINES HALBKUGELZYLINDERS BEI VERDUENNTER HYPERSCHALLSTROEMUNG MIT HILFE DER ELEKTRONENSTRAHLTECHNIK]
K. A. Buetefisch *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 112-123 In GERMAN (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

N90-24234# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.). Abt. verduennte/reale Gase.
CALCULATION OF CORRECTION TERMS FOR FORCES AND MOMENT MEASUREMENTS IN RADIAL FLOW FIELD OF HYPERSONIC SPHERIC NOZZLES [BERECHNUNG VON KORREKTURGROESSEN FUER KRAFT- UND MOMENTENMESSUNGEN IM RADIALSTROEMUNGSFELD HYPERSONISCHER KEGELDUESEN]
Thomas Poertner *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 145-154 In GERMAN (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

N90-25035*# Norfolk State Univ., VA.
GROUND EVALUATION OF SEEDING AN IN-FLIGHT WINGTIP VORTEX USING INFRARED IMAGING FLOW VISUALIZATION TECHNIQUE
Ted Akinyanju *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 38-40 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 01A

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N90-24257*# Environmental Research Inst. of Michigan, Ann Arbor.

SYNTHETIC APERTURE RADAR IMAGERY OF AIRPORTS AND SURROUNDING AREAS: DENVER STAPLETON INTERNATIONAL AIRPORT Final Report, 31 Aug. 1987 - 30 Nov. 1989

Robert G. Onstott and Denise J. Gineris Washington Jul. 1990 385 p

(Contract NAS1-18465)

(NASA-CR-4305; NAS 1.26:4305; DOT/FAA/DS-89/16) Avail: NTIS HC A17/MF A02 CSCL 01C

This is the third in a series of three reports which address the statistical description of ground clutter at an airport and in the surrounding area. These data are being utilized in a program to detect microbursts. Synthetic aperture radar (SAR) data were collected at the Denver Stapleton Airport using a set of parameters which closely match those which are anticipated to be utilized by an aircraft on approach to an airport. These data and the results of the clutter study are described. Scenes of 13 x 10 km were imaged at 9.38 GHz and HH-, VV-, and HV-polarizations, and contain airport grounds and facilities (up to 14 percent), cultural areas (more than 50 percent), and rural areas (up to 6 percent). Incidence angles range from 40 to 84 deg. At the largest depression angles the distributed targets, such as forest, fields, water, and residential, rarely had mean scattering coefficients greater than -10 dB. From 30 to 80 percent of an image had scattering coefficients less than -20 dB. About 1 to 10 percent of the scattering coefficients exceeded 0 dB, and from 0 to 1 percent above 10 dB. In examining the average backscatter coefficients at large angles, the clutter types cluster according to the following groups: (1) terminals (-3 dB), (2) city and industrial (-7 dB), (3) warehouse (-10 dB), (4) urban and residential (-14 dB), and (5) grass (-24 dB). Author

N90-24258# PPG Industries, Inc., Huntsville, AL. Aircraft Products Div.

FORWARD CANOPY FEASIBILITY AND THRU-THE-CANOPY (TTC) EJECTION SYSTEM STUDY Final Report, Dec. 1981 - Sep. 1989

James W. Myers Jan. 1990 160 p

(Contract F33615-81-C-3403; AF Proj. 1926)

(AD-A220360; PPG-CDRL-6; WRDC-TR-89-3118) Avail: NTIS HC A08/MF A01 CSCL 01/3

This study presents the development and production of a half scale forward canopy to integrate bird strike protection for the T-38 aircraft. Actual half scale T-38 forward canopy fabrication process and production procedures are included. Forward canopy cross sections that should provide the desired bird strike protection level as recommended by the Univ. of Dayton Research Institute and PPG Industries, Inc. are included. A detailed final report on the T-38 Clear Path Egress (CPE) System which includes technology assessment and concept review of six systems is also included. Integration of the forward canopy, the T-38 airframe, and thru-the-canopy (TTC) escape capability systems have been mechanically and economically considered. GRA

N90-24259# Simula, Inc., Phoenix, AZ.

OPERATIONAL EFFECTS ON CRASHWORTHY SEAT ATTENUATORS Final Report, Sep. 1987 - Nov. 1989

Marvin Kent Richards Mar. 1990 141 p

(Contract DAAJ02-87-C-0022)

(AD-A221148; USAAVSCOM-TR-89-D-21) Avail: NTIS HC A07/MF A01 CSCL 01/3

Energy absorbers were removed from crashworthy crew and troop seats aboard UH-60A Black Hawk helicopters which had been in service for up to nine years. The fielded energy absorbers were tested both statistically and dynamically and the load-deflection characteristics were compared to new energy absorbers to determine the operational effects. There were three energy absorber types tested: inversion tube, rolling torus, and wire bender. Seat systems with energy types absorbers not meeting the manufacturer's specified load-deflection characteristics were modeled by computer simulation to determine the change in injury potential in a vertical crash scenario. In general, the inversion tube and rolling torus energy absorbers' performance did not change as compared to new attenuators. The wire benders, however, had a failure rate of 48 percent which appeared to be fatigue related. GRA

N90-24260# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Transport- und Verkehrsflugzeuge.

AERODYNAMIC DEVELOPMENT PERSPECTIVE FOR TRAFFIC AEROPLANES [AERODYNAMISCHE ENTWICKLUNGSPERSPEKTIVEN FUER VERKEHRSFLUGZEUGE]

R. Hilbig and J. Szodruch 1989 26 p In GERMAN

(DGLR-89-141; ETN-90-96781) Avail: NTIS HC A03/MF A01

The market possibilities for Airbus Industry are reviewed and the problems of increasing flight needs and atmospheric pollution are dicussed. Several tables and graphs are presented which show the evolution in the aerodynamic research in subsonics and hypersonics: the friction resistance could be reduced by influence of the turbulence structure or by a variable wing curve. ESA

N90-24261# Deutsche Lufthansa A.G., Hamburg (Germany, F.R.).

THE 30TH AIRLINES INTERNATIONAL ELECTRONICS MEETING PROCEEDINGS

1989 305 p Meeting held in Berlin, Fed. Republic of Germany, 15-17 Nov. 1989

(ETN-90-96973) Avail: NTIS HC A14/MF A02

The subjects of computer controlled systems, radio communication and navigation and sensors and instruments are discussed. Test equipment and facilities are considered. Autoflight guidance, stability augmentation and autothrottle are discussed. Electronic engine control, electronic displays and ground proximity and windshear warnings are considered. Flight data recording, aircraft condition monitoring, engine instrumentation and a wide range of other areas of concern to commercial airlines are discussed. ESA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N90-24262# Naval Postgraduate School, Monterey, CA.

ESTABLISHING A GPS-BASELINE BETWEEN SEATTLE, WASHINGTON AND MONTEREY, CALIFORNIA M.S. Thesis

James E. Waddell, Jr. Dec. 1989 49 p

(AD-A220069) Avail: NTIS HC A03/MF A01 CSCL 17/7

A baseline of about 1200 km between Seattle, Washington, and Monterey, California, was measured repeatedly over a six-month period using five-channel, single-frequency Global Positioning System (GPS) receivers with carrier phase differencing techniques and broadcast ephemeris. The averaged GPS baseline length compared favorably with the length determined from control points established by Very Long Baseline Interferometry (VLBI), the agreement being on the order of 0.01 ppm (1 cm in 1200 km) which is about the precision expected of the VLBI technique itself. The quality of the agreement is startling, considering the relatively poorer precision (about 1 ppm) expected for the GPS receivers and techniques employed. To achieve this agreement, TPS

observations varying more than 1 ppm from the computed mean length were discarded, and a scale factor of -0.2 ppm for the transformation from GPS to VLBI reference frames was applied, which had been estimated from other studies. The results suggest that accuracies of better than a decimeter are achievable over lines of 1000 km using single-frequency GPS equipment. GRA

N90-24263# Federal Aviation Administration, Washington, DC. Office of Aviation Policy and Plans.
IFR AIRCRAFT HANDLED FORECAST BY AIR ROUTE TRAFFIC CONTROL CENTER: FISCAL YEARS 1990 TO 2005 Final Report
Feb. 1990 70 p
(Contract DTFA01-88-C-00059)
(AD-A220312; FAA-APO-90-3) Avail: NTIS HC A04/MF A01 CSCL 17/7

This report provides forecasts of Instrument Flight Rule (IFR) aircraft handled by Federal Aviation Administration Air Route Traffic Control Centers. The current study is an update to FAA-AVP 80-4, IFR AIRCRAFT HANDLED Forecast by Air Route Traffic Control Center, Fiscal Years 1980 to 1991. The forecasts serve as a base for the FAA planning and budget process in determining future requirements for facilities, equipment, and manpower. The forecasts show that total aircraft handled will increase from 37.0 million in FY 1989 to 50.6 million in FY 2005. These national total numbers along with the intervening years are broken down by FAA region and for each air route traffic control center in this report. This appendix contains a technical description of the data sources, methodology, and regression models used in the Instrument Flight Rule (IFR), aircraft activity forecasts for each Air Route Traffic Control Center. Section 2 presents an overview of the forecasting model for IFR aircraft activity. Section 3 provides a detailed description of the various data bases used in the forecasts. Section 4 allocating county data to the various ARTCCs, and estimating models to forecast IFR aviation activity. The final section presents the forecasting models for IFR departures and overs at each ARTCC. GRA

N90-24264# Aeronautical Research Labs., Melbourne (Australia).
APPLICATION OF OPTIMAL TRACKING METHODS TO AIRCRAFT TERRAIN FOLLOWING Aircraft Systems Technical Memorandum
M. E. Halpern Dec. 1989 29 p
(AD-A221099; ARL-SYS-TM-133; DODA-AR-005-644) Avail: NTIS HC A03/MF A01 CSCL 17/7

Some approaches using least squares optimization for improving tracking control system performance are developed and applied to a simplified aircraft terrain following problem. A basic tracking control system is described. The design of an optimal moving-average precompensator which gives improved tracking performance over the basic system is then given. This filter design is modified to use future values of the reference input to give further improved performance. An approach involving the design of an optimal signal to drive the control system is also given. These approaches are applied to an aircraft terrain following system simulation. The performance obtained is examined and discussed. It appears that as worthwhile performance improvements can be obtained by using the algorithms which make use of knowledge of future terrain as could be obtained from a terrain data-base. These improvements allow the aircraft to fly at lower altitudes. GRA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.For land transportation vehicles see *85 Urban Technology and Transportation.*

N90-24265*# Psycho-Linguistic Research Associates, Woodside, CA.
EVALUATION OF SPEECH RECOGNIZERS FOR USE IN ADVANCED COMBAT HELICOPTER CREW STATION RESEARCH AND DEVELOPMENT
Carol A. Simpson Mar. 1990 90 p Prepared in cooperation with Army Aviation Systems Command, Moffett Field, CA
(Contract NAS2-12425)
(NASA-CR-177547; A-90090; NAS 1.26:177547; USAAVSCOM-TM-90-A-001) Avail: NTIS HC A05/MF A01 CSCL 01C

The U.S. Army Crew Station Research and Development Facility uses vintage 1984 speech recognizers. An evaluation was performed of newer off-the-shelf speech recognition devices to determine whether newer technology performance and capabilities are substantially better than that of the Army's current speech recognizers. The Phonetic Discrimination (PD-100) Test was used to compare recognizer performance in two ambient noise conditions: quiet office and helicopter noise. Test tokens were spoken by males and females and in isolated-word and connected-work mode. Better overall recognition accuracy was obtained from the newer recognizers. Recognizer capabilities needed to support the development of human factors design requirements for speech command systems in advanced combat helicopters are listed. Author

N90-24266*# California State Polytechnic Univ., Pomona.
NASA/USRA HIGH ALTITUDE RECONNAISSANCE AIRCRAFT
Michael Richardson, Juan Gudino, Kenny Chen, Tai Luong, Dave Wilkerson, and Anoosh Keyvani 1 Jul. 1990 106 p
(Contract NASw-4435)
(NASA-CR-186685; NAS 1.26:186685) Avail: NTIS HC A06/MF A01 CSCL 01C

At the equator, the ozone layer ranges from approximately 80,000 to 130,000+ feet which is beyond the capabilities of the ER-2, NASA's current high altitude reconnaissance aircraft. This project is geared to designing an aircraft that can study the ozone layer at the equator. This aircraft must be able to cruise at 130,000 lbs. of payload. In addition, the aircraft must have a minimum of a 6,000 mile range. The low Mach number, payload, and long cruising time are all constraints imposed by the air sampling equipment. A pilot must be able to take control in the event of unforseen difficulties. Three aircraft configurations were determined to be the most suitable for meeting the above requirements, a joined-wing, a bi-plane, and a twin-boom conventional airplane. The techniques used have been deemed reasonable within the limits of 1990 technology. The performance of each configuration is analyzed to investigate the feasibility of the project requirements. In the event that a requirement can not be obtained within the given constraints, recommendations for proposal modifications are given. Author

N90-24267# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Transport- und Verkehrsflugzeuge.
TRANSONIC WING CHARGE IMPROVEMENTS BY PASSIVE SHOCK BOUNDARY LAYER INTERFERENCE CONTROL: DEVELOPMENT STATUS AND PROSPECTS [TRANSSONISCHE FLUGLEISTUNGSVERBESSERUNGEN DURCH PASSIVE STOSS-GRENZSCHICHT-INTERFERENZKONTROLLE: ENTWICKLUNGSSTAND UND PERSPEKTIVEN]
P. Thiede 1989 7 p In GERMAN Presented at DLGR-Jahrestagung, Hamburg, Fed. Republic of Germany, 2-4 Oct.

1989
(ETN-90-96463) Avail: NTIS HC A02/MF A01

A digital simulation of viscous transonic profile flows with shock ventilation is presented. Development status and results of an iterative coupled local calculation process are described. The aerodynamic and structural project can be evaluated in order to optimally integrate the ventilation apparatus into the wing structure. The experimental results show that the ventilation effect weakens shocks, slows down the shock induced damping and reduces the air resistance by 3 percent. ESA

N90-24268# Royal Air Force Coll., Cranwell (England). Dept. of Transport Technology.
A STUDY OF THE TECHNOLOGY REQUIRED FOR ADVANCED VERTICAL TAKE-OFF AIRCRAFT M.S. Thesis - Loughborough Univ. of Technol.
R. I. Kilford 1989 142 p
(ETN-90-96786) Copyright Avail: NTIS HC A07/MF A01

Reasons for the desirability of VSTOL aircraft and previous projects are discussed. Main design areas are considered and related to future requirements. An attempt to choose a configuration and produce a theoretical design for such an aircraft is made. The tandem fan design is concluded to be the most suitable to produce a fighter aircraft that can be put to economical operational use in the future. ESA

N90-24269# Technische Univ., Brunswick (Germany, F.R.). Fakultaet fuer Maschinenbau und Elektroechnik.
AERODYNAMICS AND FLIGHT MECHANICS OF FORMATION FLIGHT Ph.D. Thesis [BEITRAEGE ZU AERODYNAMIK UND FLUGMECHANIK DES FORMATIONSFLUGES]
Markus Beukenberg 1989 201 p In GERMAN
(ETN-90-96497) Avail: NTIS HC A10/MF A02

The power saving in formation flight is theoretically calculated by means of the aerofoil theory. Aspect ratio, arrow, streamlining and size ratio of wings, horizontal and lateral fins were not taken into account. Examples show that the longitudinal distance has no influence on the available total power saving but on the distribution on the aeroplanes. The power saving increases quickly with the horizontal and cross distances and the upward factor. ESA

N90-24270# Army Materials Technology Lab., Watertown, MA. Polymer Research Branch.
HPLC ANALYSIS OF HELICOPTER ROTOR BLADE MATERIALS Final Report
Gary L. Hagnauer and David A. Dunn Mar. 1990 42 p
(DA Proj. 1L1-62105-AH-84)
(AD-A221121; MTL-TR-90-12) Avail: NTIS HC A03/MF A01 CSCL 01/3

This report describes high performance liquid chromatography (HPLC) test methods developed for the quality assurance of organic materials used in the manufacture of Army helicopter rotor blades. Since the chemical compositions of most of the organic materials were unknown at the start of this project, HPLC was employed to help identify components in specimens. Test methods were developed and then applied to monitor the chemical compositions of specimens received from the manufacturer during blade fabrication. Six HPLC test methods were used to evaluate eight sets of specimens of 12 different materials received over a span of three years. The HPLC test methods included size-exclusion, normal-phase, and reverse bonded-phase chromatography techniques and employed a variety of columns, mobile phases, and detectors. Major changes in chemical composition and variations in relative concentrations of chemical components were noted in seven of the 12 materials monitored during the course of this study. GRA

N90-25043*# Washington Univ., Seattle. Dept. of Aeronautics and Astronautics.
CONCEPTUAL DESIGN FOR AEROSPACE VEHICLES Abstract Only
Louis B. Gratzer *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 71-72 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 01C

N90-25057*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.
EXTENSION-TORSION COUPLING BEHAVIOR OF ADVANCED COMPOSITE TILT-ROTOR BLADES
J. B. Kosmatka *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 105-110 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 01C

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N90-24271# Naval Postgraduate School, Monterey, CA.
APPLICATION OF NEURAL NETWORKS TO THE F/A-18 ENGINE CONDITION MONITORING SYSTEM M.S. Thesis
Joseph T. Gengo Sep. 1989 125 p
(AD-A219820) Avail: NTIS HC A06/MF A01 CSCL 21/5

Neural networks were applied to the Engine Condition and Monitoring System of the F/A-18 aircraft. Due to recent fleet experience with compressor blade failures in flight, neural networks were applied to three engine conditions, flameout due to compressor failures, normal operating conditions, and low oil pressure conditions. An attempt was made to predict compressor failure using the neural networks. A back propagation and back propagation/Kohonen network were successfully tested in recognizing the various conditions with data previously unseen by the networks. Both networks demonstrated promise in predicting failures although not enough data was available for conclusive results. GRA

N90-24272# Technische Hochschule, Aachen (Germany, F.R.). Inst. fuer Strahlantriebe und Turboarbeitsmaschinen.
CALCULATION OF THE AEROELASTIC BLADE STABILIZATION WITH LINEARIZED PROCESS [BERECHNUNG DER AEROELASTISCHEN SCHAUFELDAEMPFUNG MIT EINEM LINEARISIERTEN VERFAHREN]
C. Poensgen Dec. 1987 67 p In GERMAN
(Mitt-87-01; ETN-90-96475) Avail: NTIS HC A04/MF A01

From the fundamental definitions of aeroelasticity, the process was compared qualitatively to others with regard to its power capacity. It was established that a lot of processes are appropriate to solve the first problem of the turbomachines, but no sufficiently accurate process for the forecasting of unsteady aerodynamic values has yet been achieved. The Smith-Whitehead process was compared with others and used for the calculation of experimental data and for a transonic profile stream. ESA

N90-24273*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EXPERIMENTAL AND ANALYTICAL STUDY OF CLOSE-COUPLED VENTRAL NOZZLES FOR ASTOVL AIRCRAFT
Jack G. McArdle and C. Frederic Smith (Sverdrup Technology, Inc., Cleveland, OH.) 1990 16 p Proposed for presentation at the International Powered Lift Conference, London, England, 29-31 Aug. 1990; sponsored by Royal Aeronautical Society
(NASA-TM-103170; E-5499; NAS 1.15:103170) Avail: NTIS HC A03/MF A01 CSCL 21E

Flow in a generic ventral nozzle system was studied experimentally and analytically with a block version of the PARC3D computational fluid dynamics program (a full Navier-Stokes equation solver) in order to evaluate the program's ability to predict system performance and internal flow patterns. For the experimental work a one-third-size model tailpipe with a single large rectangular ventral nozzle mounted normal to the tailpipe axis was tested with unheated air at steady-state pressure ratios up to 4.0. The end of the tailpipe was closed to simulate a blocked exhaust nozzle. Measurements showed about 5 1/2 percent flow-turning loss, reasonable nozzle performance coefficients, and a significant aftward axial component of thrust due to flow turning loss, reasonable nozzle performance coefficients, and a significant aftward axial component of thrust due to flow turning more than 90 deg. Flow behavior into and through the ventral duct is discussed and illustrated with paint streak flow visualization photographs. For the analytical work the same ventral system configuration was modeled with two computational grids to evaluate the effect of grid density. Both grids gave good results. The finer-grid solution produced more detailed flow patterns and predicted performance parameters, such as thrust and discharge coefficient, within 1 percent of the measured values. PARC3D flow visualization images are shown for comparison with the paint streak photographs. Modeling and computational issues encountered in the analytical work are discussed. Author

N90-24274*# General Motors Corp., Indianapolis, IN. Allison Gas Turbine Div.
ADVANCED GEARBOX TECHNOLOGY Final Report, Aug. 1984 - Jan. 1987
N. E. Anderson, R. W. Cedoz, E. E. Salama, and D. A. Wagner Jun. 1987 142 p Presented at the AIAA/SAE/ASME/ASEE 23rd Joint Propulsion Conference, San Diego, CA, Jun. 1987
(Contract NAS3-24341)
(NASA-CR-179625; NAS 1.26:179625; EDR-12909) Avail: NTIS HC A07/MF A01 CSCL 21E

An advanced 13,000 HP, counterrotating (CR) gearbox was designed and successfully tested to provide a technology base for future designs of geared propfan propulsion systems for both commercial and military aircraft. The advanced technology CR gearbox was designed for high efficiency, low weight, long life, and improved maintainability. The differential planetary CR gearbox features double helical gears, double row cylindrical roller bearings integral with planet gears, tapered roller prop support bearings, and a flexible ring gear and diaphragm to provide load sharing. A new Allison propfan back-to-back gearbox test facility was constructed. Extensive rotating and stationary instrumentation was used to measure temperature, strain, vibration, deflection and efficiency under representative flight operating conditions. The tests verified smooth, efficient gearbox operation. The highly-instrumented advanced CR gearbox was successfully tested to design speed and power (13,000 HP), and to a 115 percent overspeed condition. Measured CR gearbox efficiency was 99.3 percent at the design point based on heat loss to the oil. Tests demonstrated low vibration characteristics of double helical gearing, proper gear tooth load sharing, low stress levels, and the high load capacity of the prop tapered roller bearings. Applied external prop loads did not significantly affect gearbox temperature, vibration, or stress levels. Gearbox hardware was in excellent condition after the tests with no indication of distress. Author

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N90-24275# Naval Postgraduate School, Monterey, CA.
HELICOPTER CONTROLLABILITY M.S. Thesis
Dean Carico Sep. 1989 218 p
(AD-A220078) Avail: NTIS HC A10/MF A02 CSCL 01/3

The concept of helicopter controllability is explained. A background study reviews helicopter development in the U.S. General helicopter configurations, linearized equations of motion, stability, and piloting requirements are discussed. Helicopter flight controls, handling qualities and associated specifications are reviewed. Analytical, simulation, and flight test methods for evaluating helicopter automatic flight control systems are discussed. A generic simulation is also conducted. This thesis is intended to be used as a resource document for a helicopter stability and control course at the Naval Postgraduate School. GRA

N90-24276# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.). Abt. fuer Strukturdynamik.
ON SIMPLIFIED ANALYTICAL FLUTTER CLEARANCE PROCEDURES FOR LIGHT AIRCRAFT
Fritz Kiessling Sep. 1989 35 p
(DLR-FB-89-56; ISSN-0171-1342; ETN-90-97006) Avail: NTIS HC A03/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 17.50 DM

For light aircraft, especially gliders, it is too expensive to apply the same extensive flutter analyses which are necessary for high performance civil and military aircraft types. A specific procedure is accepted in Germany which is based on a more or less simplified ground vibration test and, depending on the test results, a statistical evaluation of flutter danger or stability calculations. Together with flight tests conducted by the manufacter, the analytical findings constitute the conditions of flutter clearance. Experiences in applying this concept are presented. ESA

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N90-24277# ARE, Inc., Riverdale, MD.
CRITERIA FOR COAL TAR SEAL COATS ON AIRPORT PAVEMENTS. VOLUME 2: LABORATORY AND FIELD STUDIES Final Report
J. E. Shook, S. W. Jenkins, M. Stroup Gardiner, D. E. Newcomb, and J. A. Epps Jan. 1990 237 p
(Contract DTFA01-86-C-00023)
(AD-A220167; DOT/FAA/PM-87/9-Vol-2) Avail: NTIS HC A11/MF A02 CSCL 11/3

Because coal tars are resistant to gasoline and jet fuel, they have been used for many years as a protective coating on asphalt pavements for airport parking areas, ramps, taxiways and runways. Applications include both coal tar emulsions and rubberized coal tar emulsions, applied with sand to provide skid resistance and stability to the seal costs. Volume 2 of the report includes the results of an experimental Laboratory and field investigation conducted at the University of Nevada at Reno. The focus on the University program was to develop test procedures that would measure workability, scuff, adhesion and fuel resistance properties of coal tar emulsion seal coats. This program developed a method for designing seal coat formulations test procedures that could be

used for quality assurance purposes. Volume 2 includes the test data generated in the study, including measurements made on field sections. GRA

N90-24278# National Aeronautical Establishment, Ottawa (Ontario). High Speed Aerodynamics Lab.
NEW TRANSONIC TEST SECTIONS FOR THE NAE 5 FT X 5 FT TRISONIC WIND TUNNEL
L. H. Ohman, D. Brown, Y. Y. Chan, R. D. Galway, S. M. Hashim, M. Khalid, A. Malek, M. Mokry, N. Tang, and J. Thain Jan. 1990 68 p Submitted for publication
(AD-A220933; NAE-AN-62; NRC-31216) Avail: NTIS HC A04/MF A01 CSCL 14/2

The NAE 5 x 5 ft blowdown wind tunnel has undergone a major upgrade of its transonic testing capabilities. Two entirely new test sections, one for testing two-dimensional models (2D) and one for testing three-dimensional models and reflection plane models (3D), were constructed. The two test sections are parts of the so-called Roll-in Roll-out Test Section System, so designed that an interchange between the two sections can be carried out within two days, a process that previously required about three weeks. The new test sections have, as before, perforated walls, but with different hole geometry, viz. slanted holes with splitter plates as opposed to normal holes in the original test sections. The design and manufacturing was carried out by Canadian companies. The two test sections were calibrated with regard to pressure distributions, flow quality (turbulence and pressure fluctuations), side wall boundary layer characteristics (2D), flow angularity and wall interference characteristics. Results from these investigations are presented and compared with corresponding data obtained in the original test sections. GRA

N90-24279# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.). Abt. fuer Strukturdynamik.
MICROCOMPUTER-AIDED GROUND VIBRATION TESTING
Fritz Kiessling Sep. 1989 45 p
(DLR-FB-89-57; ISSN-0171-1342; ETN-90-97007) Avail: NTIS HC A03/MF A01, DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 21 DM

A small test facility for ground vibration testing with sinusoidal multiple-shaker excitation is described. The data acquisition system is based on the conventional co-quad analyser technique in combination with a suitable microcomputer. Up to 128 channels are available to measure vector components. A software package was developed to aid the test engineer in preparing, performing and evaluating the test. This includes the interactive definition of the test setup, the online display of actual measurement quantities, the storage and retrieval of test results on magnetic disc and the production of lists and plots. ESA

N90-24226# Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer Thermo- und Fluiddynamik.
THE WIND TUNNEL OF THE RUHR UNIVERSITY, BOCHUM, FEDERAL REPUBLIC OF GERMANY FOR EXAMINATION OF COMPRESSIBLE STREAMS UNTIL M=6 [DER WINDKANAL DER RUHR-UNIVERSITAET BOCHUM ZUR UNTERSUCHUNG VON STROEMUNGEN BIS MA=6]
A. Schmuecker, K. Gersten, and H.-D. Papenfuss *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 1-6 In GERMAN (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

N90-24227# Technische Univ., Brunswick (Germany, F.R.).
THE GUN TUNNEL OF THE BRUNSWICK INSTITUTE FOR FLUID MECHANICS: CURRENT DEVELOPMENT STATUS [DER GUN-TUNNEL DES INSTITUTS FUER STROEMUNGSMECHANIK DER TU BRAUNSCHWEIG: DERZEITIGER AUSBAUZUSTAND]
D. Hummel and H. Petzel *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 7-40 In GERMAN (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

N90-24228# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France).
HIGH ENTHALPY HYPERSONIC WIND TUNNEL F4: GENERAL DESCRIPTION AND ASSOCIATED INSTRUMENTATION
J. P. Chevallier, J. Christophe, and A. Girard *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 41-57 (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

N90-24230# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).
THE ARC-HOT WIND TUNNEL [DER LICHTBOGENBEHEIZTE WINDKANAL (LBK) DER DLR]
Knud Kindler *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 73-92 In GERMAN (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

N90-24231# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.).
THE HYPERSONIC VACUUM WIND TUNNELS: STATUS, RESEARCH, AND NECESSARY DEVELOPMENTS [DIE HYPERSONISCHEN VAKUUMWINDKANAELE: STATUS, ANFORDERUNGEN UND NOTWENDIGE WEITERENTWICKLUNGEN]
G. Koppenwallner *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 93-111 In GERMAN (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

N90-24233# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Unternehmensbereich Transport- und Verkehrsflugzeuge.
SHORT TIME FORCE AND MOMENT MEASUREMENT SYSTEM FOR SHOCK TUBES (SFS) FOR MEASURING TIMES LESS THAN 10 ms
Josef Mertens and Klaus Koenig *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 124-144 In ENGLISH and GERMAN (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

N90-24235# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Hauptabt. Windkanaele.
INFRARED THERMOGRAPHY AT HYPERSONIC CHANNEL H2K [EINSATZ DER INFRAROT-THERMOGRAPHIE AM HYPERSCHALLKANAL H2K DER DLR KOELN]
A. Henckels and F. Maurer *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 155-168 In GERMAN (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N90-24280# European Space Agency, Paris (France).
SECOND EUROPEAN IN-ORBIT OPERATIONS TECHNOLOGY SYMPOSIUM
E. J. Rolfe, ed. Dec. 1989 430 p Symposium held in Toulouse, France, 12-14 Sep. 1989; sponsored in cooperation by ESA and CNES
(ESA-SP-297; ISBN-92-9092-030-0; ISSN-0379-6566; ETN-90-96976) Copyright Avail: NTIS HC A19/MF A03; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders

Robotics for use in space, with particular relation to orbital

servicing of spacecraft and extravehicular activity is investigated. Space stations, man tended free flyers and the Hermes manned spaceplane are particularly focused on. Operations, interfaces, tools, teleoperation, rendezvous and docking, simulation, orbital replacement units, robot components and dynamic controls are covered. For individual titles, see N90-24281 through N90-24334.

N90-24281# Tokyo Inst. of Tech. (Japan). Dept. of Mechanical Engineering Science.
TOWARD THE DEVELOPMENT OF COSMO-LAB **c18**
Yoji Umetani *In* ESA, Second European In-Orbit Operations Technology Symposuim Dec. 1989 p xxi-xxvi (For primary document see N90-24280 18-12)
Copyright Avail: NTIS HC A19/MF A03; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders

A brief summary of the annual report of Space Robotics Forum in 1988 is presented. The purpose of this Forum was to discuss technological problems related to robotics and automation in space, and it proposed a new concept on the unmanned space experiment facility called COSMO-LAB. The outline of this concept is described, emphasizing two kinds of robots, the one for EVA and IVA of the COSMO-LAB experimental module and the other for constructing the facility bus structure. ESA

N90-24282*# National Aeronautics and Space Administration, Washington, DC.
A PROPOSED CHANGE TO THE NASA STRATEGY FOR SERVICING SPACE ASSETS **c18**
George C. Levin *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p xxix-xxxi (For primary document see N90-24280 18-12)
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Given the limitations of the present Shuttle manifest, it is necessary for NASA to consider revision of its previous strategy for servicing satellites. This is particularly important in a period of tight budgets, when space assets will be difficult to replace. Therefore on-orbit assets take on additional value and keeping these assets operational will take on added importance. The key to maintaining these assets will be the long term strategy of developing a remote servicing capability which is space based and has a minimum reliance on the Shuttle. Such a strategy will require that the users of this servicing system design serviceable spacecraft at a high level and that these assets be located in or be capable of reaching orbits that are accessible to or compatible with the proposed servicing infrastructure. The infrastructure required to support this type of remote servicing architecture and the development of the necessary systems, tools, and procedures required to support a remote servicing architecture of this type are addressed. ESA

N90-24283*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ON-ORBIT OPERATIONS OF THE SPACE STATION FREEDOM ATTACHED PAYLOADS ACCOMMODATIONS EQUIPMENT **c18**
Jean Folse Lane and Joseph Stivaletti (Swales and Associates, Beltsville, MD.) *In* ESA, Second In-Orbit Operations Technology Symposium Dec. 1989 p 3-6 (For primary document see N90-24280 18-12)
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The Space Station Freedom which will serve as a base of operations for instruments performing space science is discussed. The Attached Payload Accommodation Equipment (APAE) will be a set of equipment designed to provide standard structural, power, data and thermal interfaces between payloads and the space station. The APAE is designed to minimize and simplify the on-orbit operations required for payload installation, replacement, and servicing. In addition, the APAE supplies launch support for small payloads and attitude control for payloads that required it. ESA

N90-24284*# Booz-Allen and Hamilton, Inc., Bethesda, MD.
OPERATIONS CONSIDERATIONS IN SPACE STATION FREEDOM ASSEMBLY **c18**
Stephen C. Doering and William G. Bastedo, Jr. *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 7-11 (For primary document see N90-24280 18-12)
(Contract NASw-4300)
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The importance of planning the on-orbit operations inherent in the Space Station Freedom assembly sequence is discussed. Any solution to the assembly puzzle requires the simultaneous satisfaction of many diverse constraints, including: on-orbit assembly operations, NSTS (National Space Transportation System) payload bay constraints, NSTS performance capabilities, and provision of the requisite functionality for each on-orbit configuration. Because operations are in the critical path SSFP (Space Station Freedom Program) has chosen to carefully assess assembly operations as each launch manifest is developed and evaluated. ESA

N90-24285*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ROBOTICS PROGRAM AT THE NASA GODDARD SPACE FLIGHT CENTER **c37**
Stanford Ollendorf *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 13-21 (For primary document see N90-24280 18-12)
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The NASA Goddard telerobotic program is structured to increase the scope and efficiency of what man can accomplish in space through the use of robotics. The main focus is to service Space Station Freedom and its payloads, but robotic assembly of Space Station Freedom and platforms is also anticipated. The approach being taken to achieve this by telerobotics, where manipulators can be controlled by human operators or computer programs. The Goddard Space Flight Center (GSFC) has the responsability to develop the Flight Telerobotic Servicer (FTS) for Space Station Freedom. The current plan at GSFC in support of telerobotics for Space Station Freedom and the in-orbit servicing of platforms are reviewed. Plans for ground demonstrations involving the use of an engineering test bed and an operational facility are discussed. ESA

N90-24286# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).
COLUMBUS ONBOARD FDIR CONCEPT **c18**
A. Kellner, R. Kueke, and J. Sved *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 25-29 (For primary document see N90-24280 18-12)
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The Generic Element Management (GEM) software of Columbus will feature as one of its functions, a Failure Detection Isolation and Recovery (FDIR) system of high intelligence. The main underlying technological considerations comprise the capability to cope with locally erroneous data, incomplete data and tolerance to locally erroneous coding of the fault management database. These considerations have led to the novel concept of connection matrices which represent generalized decision tables in the sense that entries are implication strengths between zero and unity representing the degree of evidence a symptom bears to an anomaly. The methodology for the automatic computation and the processing of these implication strengths in the diagnostic process and the corresponding prototype, CONNEX, is described. Subsequent to the basic technology the operational embedding of the system into the overall fault management strategy is described. In particular, the interaction of CONNEX with REFLEX, the Automated Procedure implementation of exception handling during

a reconfiguration sequence, within the hierarchical GEM concept is addressed. ESA

N90-24287# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.).
SERVICING TEST FACILITY: A HARDWARE SIMULATOR FOR TELEROBOTIC IN-ORBIT SERVICING **c18**
Bernd E. Schaefer *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 31-38 (For primary document see N90-24280 18-12)
(Contract DLR-5-575-4359)
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Automatically operating devices and manipulator systems being operated by ground-based teleoperators will be necessary during unmanned phases of the Columbus Free Flying Laboratory for both internal and external robotic manipulations. The Servicing Test Facility is to provide a facility capable of hosting the simulation of the various manipulator configurations to support concept studies, and to perform complete system verification, teleoperator training, parallel operations simultaneously to actual in-orbit manipulations, and ground operations segment verification for robotic tasks. Both the necessities for the ground operational support and the present status of definition for the facility functional and operational concept are focussed upon. ESA

N90-24288# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).
DISTRIBUTED MISSION PLANNING TECHNOLOGY FOR COLUMBUS
G. Ohlendorf, A. Kellner, and N. Schielow *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 39-44 (For primary document see N90-24280 18-12)
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The implications of the distributed Columbus planning scenario and the general anticipated architecture and concrete technological requirements for the planning tool as well as the communication infrastructure are described. A brief introduction into the concepts and functions of the planning tool MARS (Mission Activities and Resource Scheduler), which was developed with particular focus on the anticipated architecture just mentioned, is given. The concept of a linkage between MARS and the Columbus mission database application is presented. ESA

N90-24289# National Space Development Agency, Ibaraki (Japan). Tsukuba Space Center.
ADVANCED ROBOTICS FOR THE ON-ORBIT SERVICING **c37**
Mitsushige Oda *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 47-50 (For primary document see N90-24280 18-12)
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The National Space Development Agency of Japan (NASDA), which is supporting a wide range of research and development activities on space automation and robotics, is discussed. The remote manipulator system of the international space station Japanese Experiment Module (JEM), now under development, is addressed. Research effort is now concentrated on the advanced space robotics. The second generation space robotics, which will be used for an orbital servicing vehicle and other unmanned vehicles, is now the main research. The characteristics of the second generation space robotics is teleoperation and shared autonomy. The role sharing between human operator and robot will be the key issue of this advanced space robotics. ESA

N90-24290# Centre National d'Etudes Spatiales, Toulouse (France). Space Center.
IN-ORBIT OPERATIONS RESEARCH AND DEVELOPMENT PROGRAM OF THE TOULOUSE SPACE CENTER **c66**
J.-J. Runavot *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 51-56 (For primary document see N90-24280 18-12)
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Research and development activities organized round the space robotic activities, and the manned extravehicular experimentation through the development and in-flight test of a truss deployable structure (ERA) on the Soviet Space Station MIR, are discussed. The ERA experiment had three objectives: in-flight validation of modal prediction methods; in-flight qualification of the concept; development of know-how in EVA methods and procedures. The milestones of the development have been: the 0 g test in parabolic flights in Airbus A 300; the EVA rehearsal and training in pool at COMEX in France and Star City in USSR; and the Flat-Floor deployments in Aerospatiale Les Mureaux. A final synthesis gives the main lessons drawn from these developments and from the problems encountered in flight on ERA. ESA

N90-24291# Italian Space Agency, Rome.
THE SPIDER ROBOTIC SYSTEM **c37**
Simonetta DiPippo, P. G. Magnani, Walter Prendin, and Antonio Terribile (Tecnomare S.p.A., Italy) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 57-62 (For primary document see N90-24280 18-12)
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The Italian Space Agency (ASI) started a strategic long term program in the field of automation and robotics, named SPIDER (SPace Inspection Device for Extravehicular Repairs). The SPIDER system is an autonomous integrated space robot, designed primarily to perform visual inspection and precision repairing in the space stations environment. A preliminary description of the robotic system and, in particular, the manipulation subsystem, is given. ESA

N90-24292*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DEVELOPMENT OF COST-EFFECTIVE STANDARDS FOR EARTH OBSERVATION SPACECRAFT **c18**
Andrea M. Federoff (Science Applications International Corp., Los Altos, CA.) and Neville I. Marzwell *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 65-71 (For primary document see N90-24280 18-12)
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A program to accomplish a technical interdisciplinary approach to international standards development is described. Working groups include: remote sensing spacecraft, sensing systems, operations, and communication and data systems. Additionally, the software reliability and international liaison working groups are discussed. ESA

N90-24293*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
FLIGHT SUPPORT SYSTEM SERVICING AID TOOL **c31**
R. Davis *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 73-76 (For primary document see N90-24280 18-12)
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The Space Shuttle EVA on-orbit satellite servicing time is a scare commodity which has been limited for each mission to two 6-hour work periods with an intervening 40-hour rest period. New complex missions being planned require more servicing than two EVA's can accomodate. The GSFC (Goddard Space Flight Center) Satellite Servicing Project has been working for several years to develop a Serving Aid Tool to effectively extend this on-orbit servicing capability by IVA to the point that use of a master-slave bilateral force reflecting manipulator is now planned. This will be controlled from the Shuttle aft flight deck by the RMS mission specialist using a miniature hand controller while outfitted with a physical restraint system. This development is being done on a

low cost basis using demonstrated state-of-the-art commercial teleoperated system hardware and software upgraded for space flight use. ESA

N90-24294*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
HIERARCHY OF ON-ORBIT SERVICING INTERFACES **c31**
Rud V. Moe *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 77-81 (For primary document see N90-24280 18-12)
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A series of equipment interfaces is involved in on-orbit servicing operations. The end-to-end hierarchy of servicing interfaces is presented. The interface concepts presented include structure and handling, and formats for transfer of resources (power, data, fluids, etc.). Consequences on cost, performance, and service ability of the use of standard designs or unique designs with interface adapters are discussed. Implications of the interface designs compatibility with remote servicing using telerobotic servicers are discussed. ESA

N90-24295*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
EVOLUTION OF EVA CAPABILITIES FOR SPACE STATION CONSTRUCTION AND MAINTENANCE: SOVIET AND AMERICAN EXPERIENCE **c18**
Cathy D. Kramer *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 85-92 (For primary document see N90-24280 18-12)
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The evolution of both Soviet and American Extravehicular Activity (EVA) is discussed. A qualitative review evaluates each EVA with respect to risk, criticality, complexity, and duration. Graphics summarizing increase and rate of increase in productivity emphasize related advancements in the space suits, EVA tools, and equipment technology. Specifics that demonstrated ingenuity in accomplishing unplanned activities which required man's direct manipulation of large payloads and structures are presented. Accumulated EVA successes allow an effective, flexible, recommended approach for construction and maintenance of Space Station to be given in conclusion. ESA

N90-24296# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
THE EUROPEAN EVA SUIT: AN OPTIMIZED TOOL FOR HERMES/MTFF IN-ORBIT OPERATIONS **c54**
L. Siomionesco, J. R. Chevallier, A. I. Skoog, and N. Herber (Dornier System G.m.b.H., Friedrichshafen, Germany, F.R.) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 93-98 (For primary document see N90-24280 18-12)
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An historical review of the different concepts of EVA suits, both in U.S. and USSR; is given and the coherence of today's concepts in both countries is shown. The complexity of the U.S. Orbiter, and the type of missions for which it is designed lead to a ground serviced EVA suit system optimized for in-orbit autonomy and mobility. The MIR Salyut and EVA suits are fundamentally housekeeping tools for these stations. They are optimized for on-orbit adjustment and maintenance. An analysis of the technical requirements of crew protection, mobility, life support and crew productivity depending on the type of activities to be performed in-orbit is given. It shows different concepts and associated constraints. Technology developments which are required to make the European EVA space suit system a productivity optimized tool, are discussed. ESA

N90-24297# Aeritalia S.p.A., Turin (Italy). Space Systems Group.
PERSPECTIVE FEATURES OF INTERNAL AUTOMATION AND ROBOTICS FOR SUPPORTING COLUMBUS ATTACHED LABORATORY PAYLOAD OPERATIONS **c54**
Mario Cardano, Maria Stella Lavitola, Ignazio Barraco, and Marc Toussaint (European Space Agency, Paris, France) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 99-112 (For primary document see N90-24280 18-12)
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A payload operations simulation exercise was carried out in the frame of the ESA rider study on Robotics Spacecraft Servicing and Assembly (ROSSA), aimed at analyzing the perspective scenarios and relevance for internal automation and robotics support to the Columbus Attached Laboratory payload mission. Detailed flight operations sequences were generated and analyzed for a set of pressurized payload elements. The preliminary results show that many opportunities for supporting crew activities with internal automation and robotics exist, but internal automation and robotics for some tasks may not be trivial. Additional requirement reviews and preparation activities will lead to the identification of promising concepts to be further investigated in the frame of automation and robotics ground testbed activities. ESA

N90-24298# McDonnell-Douglas Space Systems Co., Huntington Beach, CA. Space Station Div.
TELEROBOTIC APPLICATION TO EVA **c54**
Davis E. Anderson *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 115-121 (For primary document see N90-24280 18-12)
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An investigation of EVA/telerobotic cooperation dynamics through development of a data base that incorporates neutral buoyancy testing, verification, and demonstration is presented. A division between human and telerobotic Extravehicular Activity (EVA) tasks is defined. A propellant tank farm neutral buoyancy experiment is discussed as a combination of telerobot preferred, human preferred, and interchangeable elements. The capabilities of humans and telerobots to interact during such EVA operations are applied to the EVA requirements for the operation to determine the best mix of man and machine. The resulting cooperative scenarios are verified by neutral buoyancy simulation. ESA

N90-24299# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
HERA AND EVA CO-OPERATION SCENARIOS **c54**
F. Didot and W. Luettgen *In its* Second European In-Orbit Operations Technology Symposium Dec. 1989 p 123-128 (For primary document see N90-24280 18-12)
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Co-operation of EVA astronauts and the Hermes Robot Arm (HERA) for in-orbit servicing operations is addressed. The Columbus Free Flying Laboratory (Free Flyer) has a system life of thirty years. In order to fulfil this specification, concept of a serviceable Resource Module (RM) was issued. Every six months, the Hermes spacecraft will perform servicing tasks on the Free Flyer. The external servicing tasks consist mainly of spacecraft inspection and Orbital Replaceable Unit (ORU) exchange. These servicing tasks can be done either by EVA servicing, or by HERA. Some strategies for EVA mission preparation and scenarios for EVA-HERA combined servicing mission are proposed. The benefit the servicing mission will gain in EVA-HERA co-operations is stated. ESA

N90-24300# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

ROBOT-BASED EQUIPMENT MANIPULATION AND TRANSPORTATION FOR THE COLUMBUS FREE FLYING LABORATORY c54

W. DePeuter, P. Putz, and G. Colombina (Tecnospazio S.p.A., Milan, Italy) *In its* Second European In-Orbit Operations Technology Symposium Dec. 1989 p 129-134 (For primary document see N90-24280 18-12)

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The concept for a robot-based Equipment Manipulation and Transportation System (EMATS) for the Columbus Free Flying Laboratory is described. EMATS could not only automatically provide the greater part of the payload facility handling and logistics functions during the unmanned microgravity periods, but also perform unmanned servicing operations in conjunction with various logistics vehicles concepts and assist the crew during manned servicing from the Space Station Freedom and from Hermes. To that end, a variety of telerobotics features are foreseen such as teleoperation and supervised automatic operation from ground or from a small control station aboard the Free Flyer, Hermes, or the Space Station Freedom. The overall EMATS architecture is summarized and the flexibility of the concept is illustrated by results from computer graphics simulations. ESA

N90-24301# MATRA Espace, Paris-Velizy (France).

THE HERMES ROBOT ARM TELEOPERATION AND CONTROL CONCEPT c54

G. Andre and P. Schoonejans (Fokker B.V., Amsterdam, Netherlands) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 137-149 Sponsored in part by Fokker B.V., Amsterdam, Netherlands and ESA (For primary document see N90-24280 18-12)

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The teleoperation and control concepts for the Hermes Robot Arm (HERA) currently under development are presented. Emphasis is placed on the conceptual design of the control architecture and the experimental simulation for evaluation of man machine interfaces for a remotely controlled manipulator on-board a manned spacecraft. Interest and limitations induced by trends in fusion of teleoperation requirements with cockpit automation organization are identified. ESA

N90-24302*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

TELEROBOTIC ARCHITECTURE FOR AN ON-ORBIT SERVICER c54

Neville I. Marzwell *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 151-157 (For primary document see N90-24280 18-12)

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An on-orbit servicer system has unique functional and human factors requirements. The servicing, whether it be teleoperation task, a supervised control task or an autonomous robotic task, the man-machine interface function is likely to be a bottleneck to the operation of the whole system. The man-machine interface system for a space servicer, namely the operator control station, includes several subsystems with a hierarchical architecture. Those subsystems include a reasoning and planning subsystem (also known as the artificial intelligence planner), a run-time control subsystem, a manipulator control and mechanization subsystem, and a sensing and perception subsystem. Indicative of these potentials, certain generic tasks, suggestive of space assembly, maintenance and repair, were performed in a testbed environment. Through performance in several modes: direct teleoperation, shared control, traded control, and robotic operation, the benefits of the individual technology contributions to the operation were quantized and recommendations for use in telerobotic systems were established. ESA

N90-24303# Centre National d'Etudes Spatiales, Toulouse (France).

HERA TELEOPERATION TEST FACILITY c54

V. Bourdon-Henry *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 161-165 (For primary document see N90-24280 18-12)

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The activities of the French Space Agency robotics laboratory are strongly related to the Hermes Robot Arm (HERA) project. With the purpose of providing the HERA team with an experimental support, a testbed was built to simulate some specific HERA tasks such as satellite grasping and berthing of Hermes with the Man Tended Free Flyer (MTFF) of Columbus. This set-up gives the possibility to analyze the operator performances as far as teleoperation ergonomy is concerned. The objectives of the tests performed are reviewed and an in-depth description of the test facility is given. Strong emphasis is put on test results. ESA

N90-24304# British Aerospace Dynamics Group, Bristol (England). Dept. of Human Factors.

A FLEXIBLE TELEOPERATION TEST BED FOR HUMAN FACTORS EXPERIMENTATION c54

J. L. Evans and I. G. D. Strachan (United Kingdom Atomic Energy Authority, Culham, England) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 167-171 (For primary document see N90-24280 18-12)

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Research conducted for the European Space Agency in the field of teleoperation is described. The overall aim was to design and build a telerobotic test bed which could be used for experimental investigations of the remote control of robotic manipulator in space from a ground control station. The development of the test bed, and in particular, the development of a General Purpose Robot Controller (GPRC) is described. This permitted the simultaneous control of all 6 degrees of freedom of the experimental robot. The human factors experiments which were conducted using the test bed are described. A brief summary of the principal results and conclusions is provided. ESA

N90-24305# Tohoku Univ., Sendai (Japan). Dept. of Precision Engineering.

TELEOPERATION OF A FORCE CONTROLLED ROBOT MANIPULATOR WITHOUT FORCE FEEDBACK TO A HUMAN OPERATOR c54

Masaru Uchiyama and Kosei Kitagaki *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 173-179 Sponsored in part by Ministry of Education, Science and Culture, Japan (For primary document see N90-24280 18-12)

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A teleoperation scheme of a manipulator in orbit is presented. The schemes uses no force reflection to a human operator on the ground. Instead, the manipulator is hybrid controlled: forces or velocities of the end-effector are selectively controlled. The force or velocity control modes are automatically selected by monitoring forces measured by a force/torque sensor at the wrist of the manipulator. The human operator uses only a joy stick consisting of a force/toque sensor to send commands to the manipulator. The commands are interpreted as force commands or velocity commands by the manipulator. A coefficient to convert the commands into the velocity commands is calculated theoretically based on an index to evaluate the control of collision. The scheme is implemented by a robot system on the ground. Experimental results to show its feasability are obtained. ESA

N90-24306# Technische Hochschule, Darmstadt (Germany, F.R.).
EXPERIENCES WITH AND ERROR HANDLING IN A KNOWLEDGE BASE ASSISTED SYSTEM FOR PAYLOAD EXPERIMENT AUTOMATION **c29**
G. Kegel and H. Tolle *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 183-189 Sponsored by BMFT (For primary document see N90-24280 18-12)
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The basic structure of an autonomous space experiment manipulator system and first experiences with the handling of a terrestrial laboratory space experiment mock-up simulating a microgravity payload are presented. The autonomy of the manipulator system is achieved by integrating multi-sensorial information with a hierarchical control approach. The five levels of the control system are using sensor information in a specific form of from the bottom to the top level. Every level is responsible for its own error handling mechanism reaching from direct feedback in cartesian coordinates to sequence related failure strategies. The complete implemented control scheme, and a number of sensors integrated in a multi-sensorial gripper system, thus enabling the control to perform motion-sequences planned by the knowledge based strategy level, are described. ESA

N90-24307# MATRA Espace, Paris-Velizy (France).
THE BI-ARM SERVICER: A MULTIMISSION CONCEPT AND A TECHNOLOGICAL MODEL FOR SPACE ROBOTICS **c54**
G. Andre, G. Berger, and A. Elfving (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 191-204 (For primary document see N90-24280 18-12)
(Contract ESTEC-7946/87)
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The Bi-Arm Servicer (BIAS) concept: its potential application, its conceptual design and associated system and feasability analyses, is presented. An application review where four different mission configurations, depending on the carrier type, were investigated, is given. A model mission including a reference environment and reference tasks is established and an overview of the major requirements for the BIAS system is given. The conceptual design of the BIAS is presented. The system architecture is based on two main entities: the servicer equipped with two dexterous manipulators and the teleoperation and control station. The key analyses in several disciplines are outlined and geometry, kinematics, dynamics characteristics are investigated. The sensory subsystem, coordination algorithms, and the teleoperation and control architectures are described. Three test beds and on-going demonstration experiments which support the BIAS main study are presented. ESA

N90-24308# MATRA Espace, Toulouse (France).
HERMES RENDEZVOUS AND NAVIGATION SYSTEM **c17**
Michel Frezet, Patrice Riant, Michel Janvier, and Michel Caldichoury *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 207-218 (For primary document see N90-24280 18-12)
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An overview of the requirements and concepts for the Hermes free orbital and rendezvous navigation and guidance is attempted. The whole rendezvous scenario from the end of the transfer phase up to the docking is described. The navigation system and designed for Hermes is presented, with some emphasis on the relative GPS (Global Positioning System) navigation dedicated to the homing phase and on the optical navigation during the final approach. A particular attention is devoted to the elaboration of guidance and control strategies for the homing and the final approach phases. Performances obtained in the frame of the Hermes system studies are presented. ESA

N90-24309# MATRA Espace, Toulouse (France).
ON-BOARD EXPERT SYSTEM FOR MANNED RENDEZVOUS OPERATION ASSISTANCE **c17**
A. DeSaint-Vincent and P. Marchal (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 219-225 (For primary document see N90-24280 18-12)
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The rendezvous operator assistant concept currently under study is a real time interactive system, based on artificial intelligence techniques and directed towards situation assessment and short term reactions for safety, and also mission replanning. The system functionalities and preliminary breadboarding are described and the main original features raised by the rendezvous problematics, such as the man-machine interaction and the realtime aspects, are addressed. ESA

N90-24310# Polytechnical Univ. of Madrid (Spain).
GPS NAVIGATIONAL PERFORMANCE IN SPACE RENDEZVOUS OPERATIONS **c17**
M. A. MartinezOlague, M. PerezCortes, and R. LucasRodriguez (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 227-235 (For primary document see N90-24280 18-12)
(Contract ESA-7617/88/NL)
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During a typical rendezvous operation (RVD) between Hermes and the Man Tended Free Flyer (MTFF) the relative state vector between the two space vehicles will be updated by GPS (Global Positioning System) operating in relative mode from a distance of 40 km to 100 m approximately. A method for processing GPS differential raw measurements is presented and the performance results based on a complete simulation of a separation maneuver are given. The model for the real-world dynamics is based in a Chohessy-Wiltshire solution for relative motion between target and chaser including aerodynamic and gravitational perturbations and the consideration of a perturbated elliptic orbit for the target. The navigation filter process integrated Doppler measurements (accumulated carrier cycle count) and the achieved results are very satisfactory: 0.8 m and 9 mm/s (1 sigma) for relative position and velocity respectively. ESA

N90-24311# MATRA Espace, Paris-Velizy (France).
DDTF IMPROVEMENTS FOR MORE ACCURATE SPACE DOCKING SIMULATION **c18**
D. Grimbert, P. Noirault, P. Marchal, and L. Petitjean (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 239-244 (For primary document see N90-24280 18-12)
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Europe's first confrontation with docking in space will require extensive testing to verify design and performances, and to qualify hardware. To evaluate the docking system dynamic capabilities, a unique Docking Dynamics Test Facility (DDTF) was developed which uses a nine degrees of freedom servo-motion system controlled by a real time computer that simulates the docking spacecraft in zero-g environment. The test system is described and its capabilities summarized. Emphasis is made on all the improvements that were incorporated throughout the system implementation: configuration was reworked to extend the performance range, and significant technology limitations were remedied to enhance the motion accuracy. ESA

N90-24312# MATRA Espace, Toulouse (France).
INVESTIGATIONS ON DOCKING AND BERTHING DYNAMICS **c18**
T. Blais, C. Pauvert, W. Fehse, and A. Tobias (European Space

Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 245-257 (For primary document see N90-24280 18-12)
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Some early results on an ESA comparative study are presented. The investigations of the last meters of the final approach of the rendezvous and the mating process proper are focused on. Final approach problems are presented and discussed. The contact phase for docking and the capture, the transfer and final contact phases for berthing are analyzed. Criteria to assess the reliability of the mating procedures are presented, followed by the trade of docking versus berthing. To illustrate results, realistic cases are considered: Hermes acting as the chaser rendezvousing and mating with a large range of target, from the 4 tones Eureca to the 200 tones Space Station Freedom and including the 20 tones Columbus Free Flyer. ESA

N90-24313# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
DOCKING BERTHING SYSTEMS: FUNCTIONS AND SIMULATION **c18**
A. Tobias, F. Venditti, and Neil Cable *In its* Second European In-Orbit Operations Technology Symposium Dec. 1989 p 259-270 (For primary document see N90-24280 18-12)
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Investigations made in preparation of the Hermes and Columbus program by the European Space Agency concerning docking berthing systems for pressurized passage of crew and goods are presented. The investigations included the identification of requirements derived from the missions, the scenarios and the characteristics of participating spacecraft, the analysis of functions and operations, the identification of suitable implementation concepts and the preparation and improvement of simulation tools for the analysis of contact dynamics. An on-going plan for further investigations, including extensive computer simulations, manufacturing of models and testing in a motion facility, is presented. ESA

N90-24314# Norwegian Marine Technology Research Inst., Trondheim.
GROUNDBASED SIMULATIONS OF IN-ORBIT OPERATIONS **c14**
T. E. Berg and M. Villaboe *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 273-279 (For primary document see N90-24280 18-12)
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The need for groundbased facilities for studies of manned and unmanned in-orbit operations is documented in numerous U.S., Soviet and European studies. The cost of simulating such operations are high. During development of numerical and physical simulators care should be taken to obtain a consistent set of simulators without undue overlapp between each of them. To obtain this result simulator requirements have to be specified by designers, hardware suppliers and operational specialists at an early stage in the project. Numerical and physical simulators emphasizing the neutral buoyancy facility as a tool for design, hardware and operational procedure testing, are described. ESA

N90-24315# Singer-Link-Miles Ltd., Lancing (England).
ROBOTIC SIMULATION SUPPORT TO SYSTEMS DEVELOPMENT **c37**
R. M. Daintree and G. K. Speed *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 281-287 (For primary document see N90-24280 18-12)
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Robotics and telemanipulation will be key features of future space missions and the systems upon which these missions depend for their success will require extensive design and development effort. An intrinsic and important feature of this preparatory activity will be simulations to support the development of systems from their conceptual design through to their use in operational missions. The role of simulation in the development of space robotic systems in general is outlined and by means of two recent examples of activity, some of the considerations arising from the application of these techniques to particular aspects of evolving an in-orbit infrastructure, are discussed. ESA

N90-24316# National Aerospace Lab., Amsterdam (Netherlands).
EQUIVALENT FLEXIBILITY MODELING: A NOVEL APPROACH TOWARDS RECURSIVE SIMULATION OF FLEXIBLE SPACECRAFT MANIPULATOR DYNAMICS **c37**
P. Th. L. M. vanWoerkom *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 289-295 (For primary document see N90-24280 18-12)
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For the simulation of rigid spacecraft manipulator dynamics there exists efficient recursive software. Extension of this software for the simulation of flexible spacecraft-manipulator dynamics would have important advantages. The method of Equivalent Flexibility Modelling (EFM) is outlined. Each flexible body is re-modeled as a concatenation of rigid bodies, acted upon by fictitious loads in addition to the real loads. To calculate the fictitious loads, some modifications of the software are required. A number of test cases were analyzed. The errors detected in these test cases are within the realm of computational inaccuracy. ESA

N90-24317# Technische Hochschule, Darmstadt (Germany, F.R.). Control Systems Theory and Robotics Section.
SIMULATION AND GROUND-BASED TESTING OF ORU-HANDLING WITH A BI-ARM ROBOT **c37**
H. Bruhm *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 299-308 (For primary document see N90-24280 18-12)
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With the Bi-Arm Servicer (BIAS) and the Flight Telerobotic Servicer (FTS), ESA and NASA are studying concepts of robotic systems with cooperating arms which promise increased versatility and superior performance over comparable single-arm systems for the in-orbit operations envisaged in connection with construction, operation and maintenance of the International Space Station and its accompanying unmanned elements. The importance of early validation of key technologies relied upon by such projects is discussed and the role of simulation and ground-based testing in this context is illustrated with, as example, a study on the validation of a coordination strategy for robots with cooperating arms. Following its introduction in mathematical notation, the implementation of the coordination strategy on a laboratory demonstration system in the form of a distributed algorithm is described. A design method for the coordination controller is presented and validated by simulation of ORU handling with two cooperating SMS arms. A summary of experiences from the study and recommendations concerning a possible continuation of the project are given. ESA

N90-24318# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
ROSED: ROBOTIC SERVICING DEMONSTRATOR **c37**
M. VanWinnendael, P. Gallet, and P. FelixDelCueto (Construcciones Aeronauticas S.A., Madrid, Spain) *In its* Second European In-Orbit Operations Technology Symposium Dec. 1989 p 309-314 (For primary document see N90-24280 18-12)
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The context, objectives and main requirements of a robotic servicing demonstrator, i.e., a physical ground model of an external

servicing manipulator, which is planned to become part of the ESTEC Robotics Laboratory, is described. The ROSED is meant to contribute to: robotic technology demonstration and evaluation; engineering support to HERA (Hermes Robotic Arm); familiarization of personnel; and assessment of training needs. Some general considerations about ground models of large space manipulators are mentioned, as well as some preliminary results of the ROSED Initiating Phase, an ongoing study covering the conceptual design aspects. ESA

N90-24319# National Aerospace Lab., Emmeloord (Netherlands).
THE REAL-TIME HERMES ROBOT ARM SIMULATOR: HSF-P **c37**

J. J. M. Prins, P. Dielman, and H. deJong *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 315-321 Sponsored by Netherlands Agency for Aerospace Programs (For primary document see N90-24280 18-12)
(Contract ESA-7222/87/NL)
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The Hermes manipulation system (HERA) is a sophisticated space manipulator system, which has to perform tasks ranging from berthing to tool operation in various operational modes from fully automatic to purely manual. Development and qualification of such a space-based manipulator must be supported by computer simulation facilities. The development of the so-called HERA Simulation Facilities (HSF) is addressed. The first HSF-P, a first pilot real time simulation facility, is discussed. ESA

N90-24320*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ORBITAL REPLACEMENT UNITS (ORUS) DESIGN CONSIDERATIONS **c18**

Edward Falkenhayn *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 325-328 (For primary document see N90-24280 18-12)
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The packaging of avionics and mechanisms in containers, called orbital replacement units, which permits in-orbit repair and replacement is the key to man's expanded ventures into space with increasingly costly assets. In designing ORUs, the designer must accomodate the environments of launch and space. The subjects of ORU attachment, thermal, electrical connectors, and size and configuration, are addressed. ESA

N90-24321# Space Technology Labs., Inc., El Segundo, CA.
TECHNOLOGY REQUIREMENTS FOR ON-ORBIT SERVICING OF SPACECRAFT **c18**

Otto C. Ledford and Neal Ely (Air Force Space Div., El Segundo, CA.) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 329-333 (For primary document see N90-24280 18-12)
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A study undertaken to identify the technology required to implement an on-orbit servicing capability is described. These technology requirements were derived by a top-down, requirements driven analysis. Typical satellite subsystems were examined on a generic basis, failure modes within each subsystem identified, and possible response addressed. The technology required to provide an on-orbit servicing response to each issue was identified. It was found that a system to provide servicing support to orbital assets is technically feasible, even in the near term. In most cases the technology requirements are met by modest extrapolation or demonstration of current capabilities. It appears that the deployment of a support system which offers the advantages of servicing satellites in orbit will be paced less by the requirements of overcoming technology shortfalls than by issues of spacecraft architecture and standardization. ESA

N90-24322*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SATELLITE SERVICER SYSTEM FLIGHT DEMONSTRATION PROGRAM **c18**

James S. Moore *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 337-340 (For primary document see N90-24280 18-12)
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A program to develop the capability of servicing satellites in remote locations, where a series of flight that will demonstrate autonomous rendezvous and docking, supervised autonomous Orbital Replacement Unit (ORU) exchange, supervised autonomous fluid transfer and, proximity operations for Space Station Freedom were planned, is described. The flight demonstrations are the results of several mission scenarios with complex technical objectives. Three Shuttle flights are planned to complete the multi-objective program. The major hardware elements of the program are described and discussed. Demonstration objectives and technical approaches to the flight demonstrations are discussed. Existing and developing technologies are assessed for applicability to the Satellite Servicer System (SSSFD) program. ESA

N90-24323# G and H Technology, Inc., Paris (France).
INTERCONNECTING DEVICES CONCEIVED FOR IN-ORBIT OPERATIONS **c37**

Pietro Sequi and Joe Laffin (G and H Technology, Inc., Santa Monica, CA.) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 341-350 (For primary document see N90-24280 18-12)
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Recent work to provide a coordinated approach and standard solutions to major interconnection needs of the Space Transportation System (STS) and the Space Station Freedom is discussed. Among the various connector types reviewed, the following are addressed: rectangular, blind-mate, ORU (Orbital Replacement Unit) electrical interface connectors; rack and panel, D-subminiature size connectors for EVA and robotic end-effector manipulation; connectors for 20 KHz power system; circular connectors for IVA/EVA use; cryogenic family of connectors; various in-flight disconnect type connectors. ESA

N90-24324*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DEVELOPMENT OF A FULLY AUTOMATED FLUID RESUPPLY INTERFACE SYSTEM **c18**

J. M. Cardin (Moog, Inc., East Aurora, NY.), William C. Boyd, and Mark S. Falls *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 351-358 (For primary document see N90-24280 18-12)
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The results of a cooperative effort to develop fluid components and systems that facilitate on-orbit servicing are discussed. The evolution from manual couplings to semi-automatic dual line interfaces to fully automatic multi-line resupply interfaces is traced. Hardware designs are presented in the context of solutions to requirements. Test data and user evaluations are reviewed. ESA

N90-24325# National Inst. of Standards and Technology, Gaithersburg, MD. Intelligent Controls Group.
NASREM: A FUNCTIONAL ARCHITECTURE FOR CONTROL OF THE FLIGHT TELEROBOTIC SERVICER **c37**

Ronald Lumia *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 361-365 (For primary document see N90-24280 18-12)
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The NASA/NBS (National Bureau of Standards) Standard

Reference Model for Telerobot Control System Architecture (NASREM), adopted by NASA for use in the Flight Telerobotic Servicer (FTS), a two armed telerobotic manipulator which will build and maintain the Space Station is addressed. NASREM is technology independent; the same functions must be performed by all controllers. NASREM provides the paradigm which allows the FTS to evolve with technology because standard interfaces can be defined so that functionally equivalent software and hardware modules may be interchanged. After a brief tutorial on the NASREM functional architecture, the approach to its implementation is shown. Interfaces must be defined which are capable of supporting the known algorithms. This is illustrated by considering the interfaces required for the servolevel of the NASREM functional architecture. After interface definition, the specific computer architecture for the implementation must be determined. This choice is obviously technology dependent. An example illustrating one possible mapping of the NASREM functional architecture to a particular set of computers which implements it is shown. The result of choosing the NASERM functional architecture is that it provides a technology independent paradigm which can be mapped into a technology dependent implementation capable of evolving with technology in the laboratory as well as in space. ESA

N90-24326# Fabrica Italiana Apparecchiature Radioelettriche S.p.A., Milan.

COLLISION DETECTION USING LINEAR PROGRAMMING c61

R. Gallerini and A. Sciomachen (Milan Univ., Italy) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 367-372 (For primary document see N90-24280 18-12)

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Two linear programming based algorithms for the detection of a collision between a manipulator arm and its surounding obstacles are considered on the basis of a real study case. In particular, the first algorithm uses a simplex-like method in order to find the intersections between two convex polyhedra, while the second one consists in finding the intersections between a suitable model of involved objects. A comparison between the two algorithms is presented on the basis of experimental data. ESA

N90-24327# Fokker B.V., Amsterdam (Netherlands).

THE HERMES ROBOT ARM: SYSTEM DESCRIPTION c37

R. J. Hamann and R. H. Bentall (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 373-379 (For primary document see N90-24280 18-12)

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The objectives of the phase C1 of the Hermes Robot Arm (HERA) project, which is currently in progress, are to establish a sound concept for telemanipulator system for external servicing of elements of the European in-orbit infrastructure, to define the interfaces with those elements, to assess the feasibility of critical design issues and technology and to establish the programmatics for phase C2/D. The HERA System, its operational functions and the operational scenario for a Columbus Free Flying Laboratory servicing mission are described. The configuration, the electrical architecture and the control scheme of the HERA are shown. A summary of major performance requirements is presented. An overview of the breadboarding activities planned during phase C1 to investigate critical technologies is given. ESA

N90-24328*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

NASA/GSFC SPLIT-RAIL PARALLEL GRIPPER c37

John M. Vranish and Mohammed Sharifi *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 383-387 (For primary document see N90-24280 18-12)

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The current state of development of the NASA/GSFC (Goddard Space Flight Center) Split-Rail Parallel Gripper (SRPG) is described. The SPRG has been shown to be a high performance gripper for industrial robots. It has a precise wide throw and at the same time, it is light, simple, compact, rugged, and jam-proof against side loads. Originated at the National Bureau of Standards (NBS), this gripper is undergoing further development at NASA/GSFC in pursuit of two goals: as a potential gripper for robots in space and as the basis for sensory-interactive industrial gripper as part of NASA's technology utilization program. The gripper design features, its principles of operation and how it is constructed are described. Test results are included. ESA

N90-24329# Technische Hochschule, Darmstadt (Germany, F.R.). Control Systems Theory and Robotics Section.

A THREE FINGERED MULTIJOINTED GRIPPER AS A WORKING TOOL FOR EXPERIMENTAL USE c37

W. Paetsch and M. Kaneko (Ministry of International Trade and Industry, Tsukuba, Japan) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 389-392 Sponsored by BMFT (For primary document see N90-24280 18-12)

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A three fingered, multijointed robot gripper for experimental use is presented. The mechanics as well as the control architecture are designed for this special purpose. The gripper system provides the basic means in terms of position and force control to perform experiments about grasping and object motion in a useful way. The gripper will be used to develop and evaluate different approaches of stable grasping and object manipulation for space application. ESA

N90-24330# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

HIGH PERFORMANCE PROCESSING SYSTEM FOR EMBEDDED CONTROL APPLICATIONS IN SPACE c60

A. Elfving and A. T. Sund *In its* Second European In-Orbit Operations Technology Symposium Dec. 1989 p 393-401 (For primary document see N90-24280 18-12)

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The limitations of current space qualified microprocessor systems, and the need for improving the characteristics of such systems significantly, are addressed. This is considered mandatory to implement future automation and robotics concepts. The relevant requirements for such systems are discussed. RISC (Reduced Instruction Set Computer) microprocessor technology is now breaking the performance bottleneck, and is being designed into an increasing number of systems, including military embedded systems. A brief introduction to RISC technology is given. A complete breadboard designed of an embedded system based on a RISC microprocessor is presented. This system intensionally resembles a spacecraft control computer. It is shown that such a computer can not only satisfy future performance requirements of space systems, but also power consumption, reliability, multisourcing, and software requirements. Additional benefits are flexibility of system design, easier microprocessor validation, and standardization. The current and planned activities around this RISC computer at ESA/ESTEC are presented. ESA

N90-24331# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes en Recherches Aerospatiales.

DYNAMIC MODELING AND CONTROL OF A FLEXIBLE ARM HOLDING A NON-RIGID PAYLOAD c37

P. Carton, J. P. Chretien, and M. Maurette (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 405-411 Sponsored by CNES (For primary document see N90-24280

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Payloads to be handled by space manipulators cannot always be considered as inert bodies represented by mass and inertias. They may feature flexible appendages, liquid sloshing in tanks or kinetic momentum wheels which will make their modeling and control more complex. Modeling is considered from the point of view of the connection of a dynamic model of a payload to a general purpose multi-body simulation package. Control issues are discussed in the frame of dynamic control, where the overall control loop is split up between an inner force control loop dependent only on the manipulator parameters, and on outer payload control loop which is designed for inert payloads and which performances for non-rigid ones are discussed. ESA

N90-24332# Tecnomare S.p.A. (Italy).
DYNAMICS AND CONTROL OF FREE-FLYING INSPECTION AND MAINTENANCE VEHICLE WITH MANIPULATORS **c18**
J. Marczyk and A. Bellazzi (Politecnico di Milano, Italy) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 413-427 (For primary document see N90-24280 18-12)
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The intention of this research effort is to investigate the salient dynamic characteristics and related control problems of a free-flying robotic device devoted to Extra-Vehicular Activity (EVA) in the vicinity of International Space Station. The system, comprising a rigid main-body and two independent three-link manipulators, is analyzed with the ESA multi-body code DCAP. Typical tasks and missions, such as station-keeping and attitude control with manipulator activity and payload transfer, is extensively simulated via time-domain numerical simulations. In particular, the impact of link and payload flexibility is examined from a control and performance evaluation point of view. ESA

N90-24333# Tecnomare S.p.A. (Italy).
SUPERVISORY CONTROLLED TELEMANIPULATION AND VISION SYSTEMS FOR INSPECTION AND MAINTENANCE OPERATIONS **c54**
Walter Prendin, Danilo Maddalena, Antonio Terribile, and Giovanni Sylos Labini (Italian Space Agency, Rome.) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 429-435 Sponsored by Commission of the European Communities; Istituto Mobiliare Italiano; AGIP; ANSALDO; European Nuclear Energy Agency; SAIPEM; and Tecnomare S.p.A. (For primary document see N90-24280 18-12)
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Characteristics and test results of an innovative telemanipulation system for underwater applications, based on a supervisory control scheme, are described. The system makes use of a new stereoscopic vision system to measure the workspace geometry before manipulation. The characteristics of the telemanipulation system are: computer assisted control of manipulator motion, sophisticated MMI, capability of performing a wide range of complex tasks. The telemanipulation and vision system were extensively tested and their effectiveness demonstrated through full scale trials. The applicability of these systems to space environment was analyzed in the framework of two contracts on behalf of the Italian Space Agency. ESA

N90-24334# Pisa Univ. (Italy). Centro Spazio.
FLEXIBLE TEST BED FOR SPACE TELEPRESENCE AND TELEMANIPULATION RESEARCH **c14**
M. Andrenucci, M. Bergamasco, P. Dario, and G. Sandini (Genoa Univ., Italy) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 439-443 Sponsored in part by Axis S.p.A. and IBM Italia (For primary document see N90-24280 18-12)
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The overall objective of this study is the setting up of a flexible teleoperation test bed, based around a commercially available industrial robot which will permit the experimental investigation of a variety of approaches to sensor-based control and supervision of robotic fine manipulation. The main components of the bed under development are a PUMA 562 manipulator equipped with a multifingered hand, a multicamera visual system, an interactive workstation with a force-controlled joystick, and a set of visual, force and tactile-based advanced interfaces wearable by the master operator. A conceptual analysis of overall test bed architecture and a discussion of the subsystems implemented so far, which include two different end-effectors incorporating force and tactile sensors, a remote stereo system to acquire the three dimensional structure of the operation environment, a joystick-like interface with force feedback for controlling the robot arm, a workstation for manipulating stereo representations of objects, and an instrument glove for investigating the isomorphic control of end-effector based on force feedback, are presented. ESA

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N90-24335# SRI International Corp., Menlo Park, CA.
TRANSIENT PULSE MONITOR Scientific Report No. 2, 20 May 1988 - 15 Jul. 1989
David R. Dana 27 Oct. 1989 32 p
(Contract F19628-86-C-0231; AF Proj. 2822)
(AD-A220353; GL-TR-89-0305) Avail: NTIS HC A03/MF A01 CSCL 20/3

The Transient Pulse Monitor (TPM) detects and characterizes static discharges on orbiting satellites. The TPM instrument provides a suite of electrical transient sensors to support the Photovoltaics Space Power Plus Diagnostics (PASP Plus) experiment. It measures the transient electric fields and currents that result from electrostatic discharges and thus reveals whether operations of the PASP Plus experiment lead to discharges. GRA

N90-24336# Bundeswehrsanitaetszentrum, Hamburg (Germany, F.R.). Fachbereich Maschinenbau.
EXTRAPOLATION OF MISSILE FLIGHT LINES Ph.D. Thesis [BEITRAEGE ZUR EXTRAPOLATION VON GESCHOSSFLUGBAHEN]
Wolfgang Simonis 1989 144 p In GERMAN
(ETN-90-96494) Avail: NTIS HC A07/MF A01

Air resistance factors of several missile types are approximated by Spline functions from which standard functions and global or by section-adaptation polynomials are obtained for approximation of the individual air resistance factors by perequation in Gauss and Chebyshev senses. An iterative compensation process is presented, which estimates the state values and model parameters of the classic trajectory model of the ballistics for the beginning of a short line part. The flight lines were extrapolated to the launch place with the estimated magnitudes. ESA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N90-24337# General Accounting Office, Washington, DC. National Security and International Affairs Div.
SPACE SHUTTLE: THE FUTURE OF THE VANDENBERG LAUNCH SITE NEEDS TO BE DETERMINED Report to the Chairman, Subcommittee on Strategic Forces and Nuclear Deterrence, Committee on Armed
Aug. 1988 30 p
(GAO/NSIAD-88-158; B-225026) Avail: NTIS HC A03/MF A01

Air Force activities and plans to deactivate, maintain, and reactivate the Vandenberg (space shuttle) Launch Site are discussed. Included is a General Accounting Office recommendation to the Secretary of Defense to develop a cost-effective reactivation schedule for the site from its current low-maintenance level, if it is to be preserved for future shuttle use. Author

N90-24314# Norwegian Marine Technology Research Inst., Trondheim.
GROUNDBASED SIMULATIONS OF IN-ORBIT OPERATIONS
T. E. Berg and M. Villaboe *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 273-279 (For primary document see N90-24280 18-12)
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N90-24334# Pisa Univ. (Italy). Centro Spazio.
FLEXIBLE TEST BED FOR SPACE TELEPRESENCE AND TELEMANIPULATION RESEARCH
M. Andrenucci, M. Bergamasco, P. Dario, and G. Sandini (Genoa Univ., Italy) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 439-443 Sponsored in part by Axis S.p.A. and IBM Italia (For primary document see N90-24280 18-12)
Copyright Avail: NTIS HC A19/MF A03; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

No abstracts in this category.

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N90-24338# Technische Univ., Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt.
NEPTUNE, 2000 PLUS: CONCEPT OF A HEAVY SPACE FREIGHTER FOR THE 21ST CENTURY Summary Report
Hermann H. Koelle, Thomas Altmann, and Olaf Kerinnnis 1989 68 p
(ILR-Mitt-229(1989); ETN-90-97004) Avail: NTIS HC A04/MF A01

Presently available launch vehicles lack the payload capability and economy required for developing and utilizing extraterrestrial resources during the next century. A heavy lift space freighter will have to be developed around the turn of the century. A fully reusable, three stage, ballistic launch vehicle is described as a reference concept, which could satisfy the space markets expected for the first half of the 21st century. Its take-off mass is 6000 MT, its payload capability to geostationary and lunar orbit is 100 MT. The specific transportation costs estimated depend strongly on the market size. In a high density market the specific transportation costs to low earth orbit are in the 200 to 100 (1990) $/kg bracket and are three times as high for geostationary and lunar orbit missions. Detailed mass models, standard trajectories and a typical operational scenario are presented. ESA

N90-25061*# City Coll. of the City Univ. of New York, NY. Dept. of Mechanical Engineering.
ADVANCED SPACE TRANSPORTATION TECHNOLOGIES Abstract Only
Rishi S. Raj *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 129-130 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 22B

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N90-24339# Midwest Research Inst., Golden, CO.
A LOW-COST PC-BASED TELEMETRY DATA-REDUCTION SYSTEM
D. A. Simms and C. P. Butterfield Apr. 1990 8 p Presented at the 4th National Conference on Microcomputer Applications in Energy, Tucson, AZ, 25-27 Apr. 1990
(Contract DE-AC02-83CH-10093)
(DE90-000330; SERI/TP-257-3737; CONF-9004110-1) Avail: NTIS HC A02/MF A01

The Solar Energy Research Institute's (SERI) Wind Research Branch is using Pulse Code Modulation (PCM) telemetry data-acquisition systems to study horizontal-axis wind turbines. PCM telemetry systems are used in test installations that require accurate multiple-channel measurements taken from a variety of different locations. SERI has found them ideal for use in tests requiring concurrent acquisition of data-reduction system to facilitate quick, in-the-field multiple-channel data analysis. Called the PC-PCM System, it consists of two basic components. First, AT-compatible hardware boards are used for decoding and combining PCM data streams. Up to four hardware boards can be installed in a single PC, which provides the capability to combine data from four PCM streams directly to PC disk or memory. Each stream can have up to 62 data channels. Second, a software package written for the DOS operating system was developed to simplify data-acquisition control and management. The software provides a quick, easy-to-use interface between the PC and PCM data streams. Called the Quick-Look Data Management Program, it is a comprehensive menu-driven package used to organize, acquire, process, and display information from incoming PCM data streams. This paper describes both hardware and software aspects of the SERI PC-PCM system, concentrating on features that make it useful in an experiment test environment to quickly examine and verify incoming data. Also discussed are problems and techniques associated with PC-based telemetry data acquisition, processing, and real-time display. DOE

N90-24308# MATRA Espace, Toulouse (France).
HERMES RENDEZVOUS AND NAVIGATION SYSTEM
Michel Frezet, Patrice Riant, Michel Janvier, and Michel Caldichoury *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 207-218 (For primary document see N90-24280 18-12)
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N90-24309# MATRA Espace, Toulouse (France).
ON-BOARD EXPERT SYSTEM FOR MANNED RENDEZVOUS OPERATION ASSISTANCE
A. DeSaint-Vincent and P. Marchal (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 219-225 (For primary document see N90-24280 18-12)
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N90-24310# Polytechnical Univ. of Madrid (Spain).
GPS NAVIGATIONAL PERFORMANCE IN SPACE RENDEZVOUS OPERATIONS
M. A. MartinezOlague, M. PerezCortes, and R. LucasRodriguez (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 227-235 (For primary document see N90-24280 18-12)
(Contract ESA-7617/88/NL)
Copyright Avail: NTIS HC A19/MF A03; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N90-24340*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
PROPOSAL FOR A LUNAR LANDING POD FOR SKITTER Advanced Missions Space Design Program
David Herman, Frank Huang, Mark Morelli, Chima Njaka, Michael Pope, and Michael Rice Aug. 1987 71 p
(Grant NGT-21-002-800)
(NASA-CR-184933; NAS 1.26:184933; ME-4182) Avail: NTIS HC A04/MF A01 CSCL 22B

The purpose of this project is to design a lunar landing module for the SKITTER vehicle. SKITTER is a three-legged mobile lunar transport and work platform. This lunar landing module must be able to bring SKITTER, with attached crane, from a lunar orbit to the surface of the Moon. This propulsion system is entirely self-contained and removable after touchdown. SKITTER is unmanned and must be able to touch down on the lunar surface and perform assigned tasks independently of other space or lunar vehicles. The propulsion system is designed to ensure that the vehicle will make a lunar landing within the expected velocity range. A landing gear configuration is presented to safely dissipate landing forces on lunar impact and be removed from the SKITTER structure after touchdown. The overall engineering analysis was conducted to determine an economical design to land SKITTER safely on the Moon. SKITTER will perform various tasks on the surface of the Moon. The completion of this project will determine the feasibility of landing SKITTER with the attached crane safely on the lunar surface. Author

N90-24341# Oak Ridge National Lab., TN. Dept. of Engineering Physics and Mathematics.
EFFECTS OF X RADIATION ON THE LAMPSHADE ORBITAL DEBRIS SATELLITE SHIELD, 2
M. S. Smith and R. T. Santoro Apr. 1990 9 p
(Contract DE-AC05-84OR-21400)
(DE90-008214; ORNL/TM-11514) Avail: NTIS HC A02/MF A01

One-dimensional thermo-hydrodynamic calculations have been performed to estimate the response of the lead (Pb) bumper plate and aluminum (Al) foam liquidator screen of the LAMPSHADE orbital debris satellite shield. Mass fractions in the solid, liquid, and vapor phases as a function of time after irradiation for two incident x ray spectra, were calculated using the PUFF-TFT code. Materials losses due to phase changes did not exceed 3 percent, but fracture and spallation may seriously reduce the performance of the lead component against incident debris. DOE

N90-24342# Hughes Research Labs., Malibu, CA.
FLIGHT MODEL DISCHARGE SYSTEM Final Report, Sep. 1983 - May 1989
R. R. Robson and W. S. Williamson Sep. 1989 267 p
(Contract F19628-83-C-0143; AF Proj. 2823)
(AD-A220261; HAC-REF-F4890; GL-TR-89-0270) Avail: NTIS HC A12/MF A02 CSCL 22/2

The Flight Model Discharge System (FMDS) Program is an autonomous system that detects both absolute and differential charging of high-altitude satellites and actively discharges the associated potentials before hazardous arcing levels are reached by emitting a low-energy inert-gas plasma. FMDS operating principles are based on empirical results from the Air Force SCATHA (P78-2) and NASA ATS-6 satellites, both of which successfully demonstrated the principle of safely reducing spacecraft charging levels by the emission of a low-energy space-charge-neutral plasma - effectively grounding the spacecraft frame and dielectric surfaces to the potential of the ambient space plasma. FMDS uses a xenon plasma source capable of igniting within one second and of emitting a flow of space-charge-neutral plasma containing more than 1 mA of Xe(+) ions. The spacecraft charging level is detected by sensors similar to those that operated aboard SCATHA (i.e., ion and electron electrostatic energy analyzers and surface-potential monitors). This report describes the development details for the breadboard and flight models of the FMDS instrument. Operational characteristics of the electrostatic analyzers, surface-potential monitors, transient-pulse monitor, plasma source, microprocessor-based controller, and software architecture are described. Results of vacuum-chamber testing under simulated geosynchronous environmental conditions are also presented. GRA

N90-24343# Naval Postgraduate School, Monterey, CA.
SYSTEM ANALYSIS OF A TACTICAL MULTI-SATELLITE COMMUNICATION SYSTEM M.S. Thesis
Thomas M. Clemons, III Dec. 1989 85 p
(AD-A220344) Avail: NTIS HC A05/MF A01 CSCL 22/2

Initial design study of a low altitude satellite (LASAT) communication system is performed. The use of many inexpensive, low-altitude satellites in random orbits may be a solution to vulnerability of current military communications systems. Statistical study of orbit characteristics is performed giving the mean number of satellites in view of a ground station and the coverage density of the satellite array. Waveform analysis is performed on a coded and uncoded, orthogonal, noncoherent, fast-frequency-hopped M-ary frequency-shift-keyed signal in a Rician fading channel with optimum partial band jamming. An analytical expression for the system probability of bit error is obtained and numerical results are generated for various levels of fading, jamming, and diversity. Forward error correction coding is applied using convolutional codes and Reed Solomon codes. GRA

N90-24344# Groningen Rijksuniv. (Netherlands). Dept. of Agricultural Engineering and Physics.
DYNAMIC STABILIZATION OF LARGE FLEXIBLE SPACE STRUCTURES Ph.D. Thesis
Jan Bontsema 1989 239 p
(ETN-90-96926) Avail: NTIS HC A11/MF A02

Infinite dimensional models, and lower order finite dimensional models which are more used in practice are considered. The robustness theory is a valuable guide in deciding the right balance between the order of the stabilizing controller and the robustness margin desired to avoid spillover problems. Conclusions depend on the theory used. Insight into the problem of designing robust controllers for flexible systems under uncertainly is gained but the problem is far from solved. ESA

N90-24345# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
CONTROL OF LARGE SPACE STRUCTURES Final Report, 1 Feb. 1988 - 31 Jan. 1989
Leonard Meirovitch 19 Feb. 1990 35 p
(Contract F49620-88-C-0044; AF Proj. 2302)
(AD-A221216; AFOSR-90-0515TR) Avail: NTIS HC A03/MF A01 CSCL 22/1

Work during this period was concerned with: (1) development of a new method for the derivation of the state equations of motion for the control of flexible spacecraft in terms of quasi-coordinates; and (2) development of a method for the control of spacecraft in the form of articulated flexible multi-bodies. GRA

N90-24346# Los Alamos National Lab., NM.
ONBOARD DETECTION OF INTRINSIC Ly ALPHA RADIATION FROM A NEUTRAL PARTICLE BEAM
R. T. Robiscoe (Montana State Univ., Bozeman.), D. D. Cobb, and W. B. Maier, II May 1990 27 p
(Contract W-7405-eng-36)
(DE90-010341; LA-11776-MS) Avail: NTIS HC A03/MF A01

Photometers onboard a hydrogen neutral particle beam (NPB) space platform which monitor the instrinsic radiation from excited atoms in the NPB in flight were studied. The radiation of choice is the Lyman (alpha) (Ly(alpha)) line 1216 A, emitted when the beam's (approx. equal) 7 percent fraction of H (2S) atoms is motionally quenched in the earth's magnetic field. At nominal 20-MeV NPB energy, the Ly(alpha) radiation persists at 1 percent of its initial intensity out to 100 m along the beam, and is red shifted to 1494 A when viewed from behind the exciting NPB pulse. A photosensitive detector with an approx. 5 deg field of view, placed adjacent to the NPB exit port and viewing the NPB pulse along its limb, shows marked changes in detected Ly(alpha) intensity when the NPB axis shifts direction. If the NPB pulse is nominally 50 MA x micros, and if the detector is a 1-sq cm array of 25 microm x 25 microm photosensitive pixels located in the focal plane of an 8-cm diam. f/1 LiF lens, then pixels at the brightest part of the beam image are illuminated by up to 2300 Ly(alpha) photons per NPB pulse. The pixel quantum efficiency, optics transmission losses, and a geometric correction for viewing angle reduce the maximum count rate to approx. 200 photoelectrons per pixel per pulse under realistic operating conditions, and at a limb viewing angle (i.e., angle between beam and detector axes) of (approx. equal) 6 mrad. At smaller viewing angles the pixels count rate declines rapidly, but rapidly, but becomes sensitive to small angular shifts in the NPB axis direction. In the limit of shot-noise on the pixel count, and at optimum viewing angle ((approx. equal) 0.54 mrad), it was found that a single pixel can sense beam-axis shifts of (approx. equal) (+ or -) 50 microrad. DOE

N90-24347# Lawrence Livermore National Lab., CA.
A HIERARCHICAL APPROACH TO LARGE SPACE STRUCTURE CONTROL
K. David Young 15 Jan. 1990 12 p Presented at the International Conference on Dynamics of Flexible Structures in Space, Cranfield, England, 15-18 May 1990
(Contract W-7405-eng-48)
(DE90-010681; UCRL-102927; CONF-9005174-1) Avail: NTIS HC A03/MF A01

Controlled Component Synthesis (CCS) is a CSI approach to decentralized control of large structures which was developed by the author in 1987. In the CCS process, instead of following the conventional control system design path which begins with a model of the open loop plant, the controlled plant is assembled from controlled components for which the modeling phase and the control design phase are integrated at the component level. A hierarchical approach to large space structure control which utilizes the CCS process repeatedly in a multi-level setting is presented. DOE

N90-24281# Tokyo Inst. of Tech. (Japan). Dept. of Mechanical Engineering Science.
TOWARD THE DEVELOPMENT OF COSMO-LAB
Yoji Umetani *In* ESA, Second European In-Orbit Operations Technology Symposuim Dec. 1989 p xxi-xxvi (For primary document see N90-24280 18-12)
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N90-24282*# National Aeronautics and Space Administration, Washington, DC.
A PROPOSED CHANGE TO THE NASA STRATEGY FOR SERVICING SPACE ASSETS
George C. Levin *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p xxix-xxxi (For primary document see N90-24280 18-12)
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N90-24283*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ON-ORBIT OPERATIONS OF THE SPACE STATION FREEDOM ATTACHED PAYLOADS ACCOMMODATIONS EQUIPMENT
Jean Folse Lane and Joseph Stivaletti (Swales and Associates, Beltsville, MD.) *In* ESA, Second In-Orbit Operations Technology Symposium Dec. 1989 p 3-6 (For primary document see N90-24280 18-12)
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N90-24284*# Booz-Allen and Hamilton, Inc., Bethesda, MD.
OPERATIONS CONSIDERATIONS IN SPACE STATION FREEDOM ASSEMBLY
Stephen C. Doering and William G. Bastedo, Jr. *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 7-11 (For primary document see N90-24280 18-12)
(Contract NASw-4300)
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N90-24286# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).
COLUMBUS ONBOARD FDIR CONCEPT
A. Kellner, R. Kueke, and J. Sved *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 25-29 (For primary document see N90-24280 18-12)
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N90-24287# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.).
SERVICING TEST FACILITY: A HARDWARE SIMULATOR FOR TELEROBOTIC IN-ORBIT SERVICING
Bernd E. Schaefer *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 31-38 (For primary document see N90-24280 18-12)

(Contract DLR-5-575-4359)
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N90-24292*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DEVELOPMENT OF COST-EFFECTIVE STANDARDS FOR EARTH OBSERVATION SPACECRAFT
Andrea M. Federoff (Science Applications International Corp., Los Altos, CA.) and Neville I. Marzwell *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 65-71 (For primary document see N90-24280 18-12)
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N90-24295*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
EVOLUTION OF EVA CAPABILITIES FOR SPACE STATION CONSTRUCTION AND MAINTENANCE: SOVIET AND AMERICAN EXPERIENCE
Cathy D. Kramer *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 85-92 (For primary document see N90-24280 18-12)
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N90-24311# MATRA Espace, Paris-Velizy (France).
DDTF IMPROVEMENTS FOR MORE ACCURATE SPACE DOCKING SIMULATION
D. Grimbert, P. Noirault, P. Marchal, and L. Petitjean (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 239-244 (For primary document see N90-24280 18-12)
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N90-24312# MATRA Espace, Toulouse (France).
INVESTIGATIONS ON DOCKING AND BERTHING DYNAMICS
T. Blais, C. Pauvert, W. Fehse, and A. Tobias (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 245-257 (For primary document see N90-24280 18-12)
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N90-24313# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
DOCKING BERTHING SYSTEMS: FUNCTIONS AND SIMULATION
A. Tobias, F. Venditti, and Neil Cable *In its* Second European In-Orbit Operations Technology Symposium Dec. 1989 p 259-270 (For primary document see N90-24280 18-12)
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N90-24320*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ORBITAL REPLACEMENT UNITS (ORUS) DESIGN CONSIDERATIONS
Edward Falkenhayn *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 325-328 (For primary document see N90-24280 18-12)
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N90-24321# Space Technology Labs., Inc., El Segundo, CA.
TECHNOLOGY REQUIREMENTS FOR ON-ORBIT SERVICING OF SPACECRAFT
Otto C. Ledford and Neal Ely (Air Force Space Div., El Segundo, CA.) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 329-333 (For primary document see N90-24280 18-12)
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N90-24322*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SATELLITE SERVICER SYSTEM FLIGHT DEMONSTRATION PROGRAM
James S. Moore *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 337-340 (For primary document see N90-24280 18-12)
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N90-24324*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DEVELOPMENT OF A FULLY AUTOMATED FLUID RESUPPLY INTERFACE SYSTEM
J. M. Cardin (Moog, Inc., East Aurora, NY.), William C. Boyd, and Mark S. Falls *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 351-358 (For primary document see N90-24280 18-12)
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N90-24332# Tecnomare S.p.A. (Italy).
DYNAMICS AND CONTROL OF FREE-FLYING INSPECTION AND MAINTENANCE VEHICLE WITH MANIPULATORS
J. Marczyk and A. Bellazzi (Politecnico di Milano, Italy) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 413-427 (For primary document see N90-24280 18-12)
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N90-24494# British Aerospace Public Ltd. Co., Stevenage (England).
DESIGN AND DEVELOPMENT OF A SPACECRAFT STABILITY BOOM
J. Adams *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 217-222 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

N90-24503# Sener S.A., Las Arenas (Spain).
COLUMBUS SCIENTIFIC AIRLOCK
C. Compostizo and C. Ariza *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 281-288 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

N90-24980*# Military Academy, West Point, NY. Dept. of Physics.
UTILIZATION OF MOIRE PATTERNS AS AN ORBITAL DOCKING AID TO SPACE SHUTTLE/SPACE STATION FREEDOM Final Report
Edwin L. Dottery *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 16 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 22B

N90-24998*# Mississippi Valley State Univ., Itta Bena. Dept. of Computer Science and Mathematics.
WEIGHT AND COST FORECASTING FOR ADVANCED MANNED SPACE VEHICLES Final Report
Raymond Williams *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 7 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 22B

N90-25068*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
EXPANSION AND ORTHOGONALIZATION OF MEASURED MODES FOR STRUCTURE IDENTIFICATION
Suzanne Weaver Smith *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 148-149 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 11C

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N90-24348# Technische Univ., Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt.
SYSTEM ANALYSIS AND PROJECT OF A LASER-MOVED SPACESHIP [SYSTEMANALYSE UND ENTWURF EINER LASER-ANGETRIEBENEN RAUMFAEHRE]
Bernhard Hufenbach 1989 83 p In GERMAN; ENGLISH summary
(ILR-Mitt-232(1989); ETN-90-96483) Avail: NTIS HC A05/MF A01

A laser propulsion orbital transport system for space transportation, based on the construction of solar power satellites in gestationary orbit, is presented. To reduce the space mission costs, exploitation of raw materials and production of required components for solar power satellite stations could be realized on the lunar system. A continuous laser beam, generated by an orbit based station will be received by a collector on the orbital transport vehicle, which focuses the beam through a window into a heating chamber. The orbital based laser station converts solar energy into electrical energy. A laser sustained plasma could absorb laser energy into the propellant. A cost model estimating the life cycle cost for a 50 year period and a simulation model integrating the program subsystems are given. ESA

N90-24349*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMBUSTOR DESIGN AND ANALYSIS USING THE ROCKET COMBUSTOR INTERACTIVE DESIGN (ROCCID) METHODOLOGY
Mark D. Klem, Jerry L. Pieper, and Richard E. Walker (Aerojet TechSystems Co., Sacramento, CA.) 1990 11 p Presented at the 26th Joint Propulsion Conference, Orlando, FL, 16-18 Jul. 1990; cosponsored by AIAA, SAE, ASME, and ASEE
(NASA-TM-103165; E-5537; NAS 1.15:103165; AIAA-90-2240)
Avail: NTIS HC A03/MF A01 CSCL 21H

The ROCket Combustor Interactive Design (ROCCID) Methodology is a newly developed, interactive computer code for the design and analysis of a liquid propellant rocket combustion chamber. The application of ROCCID to design a liquid rocket combustion chamber is illustrated. Designs for a 50,000 lbf thrust and 1250 psi chamber pressure combustor using liquid oxygen (LOX)RP-1 propellants are developed and evaluated. Tradeoffs between key design parameters affecting combustor performance and stability are examined. Predicted performance and combustion stability margin for these designs are provided as a function of the combustor operating mixture ratio and chamber pressure. Author

23 CHEMISTRY AND MATERIALS (GENERAL)

N90-24350*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
NATIONAL EDUCATORS' WORKSHOP: UPDATE 1989 STANDARD EXPERIMENTS IN ENGINEERING MATERIALS SCIENCE AND TECHNOLOGY
James E. Gardner, comp. and James A. Jacobs, comp. (Norfolk State Univ., VA.) Washington May 1990 182 p Workshop held in Hampton, VA, 17-19 Oct. 1989
(Grant NAG1-976)
(NASA-CP-3074; L-16785; NAS 1.55:3074) Avail: NTIS HC A09/MF A02 CSCL 07A

Presented here is a collection of experiments presented and demonstrated at the National Educators' Workshop: Update 89, held October 17 to 19, 1989 at the National Aeronautics and Space Administration, Hampton, Virginia. The experiments related to the nature and properties of engineering materials and provided information to assist in teaching about materials in the education community. For individual titles, see N90-24351 through N90-24370.

N90-24351*# Purdue Univ., West Lafayette, IN.
INDUSTRIAL PLASTICS WASTE: IDENTIFICATION AND SEGREGATION **c27**
Edward L. Widener *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 1-
(For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11C

Throwaway plastic products, mainly packaging, are inundating our landfills and incinerators. Most are ethenic thermoplastics, which can be recycled as new products or fossil-fuels. Lab experiments are described, involving destructive and non-destructive tests for identifying and using plastics. The burn-test, with simple apparatus and familiar samples, is recommended as quick, cheap and effective. Author

N90-24352*# Norfolk State Univ., VA. Dept. of Chemistry and Physics.
DIELECTRIC DETERMINATION OF THE GLASS TRANSITION TEMPERATURE (T SUB g) **c27**
Heidi R. Ries *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 7-11 (For primary document see N90-24350 18-23)
(Contract NCC1-90)
Avail: NTIS HC A09/MF A02 CSCL 11C

The objective is to determine the glass transition temperature of a polymer using a dielectric dissipation technique. A peak in the dissipation factor versus temperature curve is expected near the glass transition temperature T sub g. It should be noted that the glass transition is gradual rather than abrupt, so that the glass transition temperature T sub g is not clearly identifiable. In this case, the glass transition temperature is defined to be the temperature at the intersection point of the tangent lines to the dissipation factor versus temperature curve above and below the transition region, as illustrated. Author

N90-24353*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DYNAMIC MECHANICAL ANALYSIS OF POLYMERIC MATERIALS **c27**

Kristen T. Kern, Wynford L. Harries (Old Dominion Univ., Norfolk, VA.), and Sheila Ann T. Long *In its* National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 13-18 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11C

Polymeric materials exhibit mechanical behavior which is dependent on temperature. Dynamic mechanical analysis measures the mechanical damping and resonant frequency of a material over a temperature range. Values of the dynamic loss modulus, storage modulus, and loss tangent can be calculated from these data. The glass transition temperature and onset temperature are obtained from curves of the dynamic moduli versus temperature. Author

N90-24354*# Battelle Pacific Northwest Labs., Richland, WA.
ANODE MATERIALS FOR ELECTROCHEMICAL WASTE DESTRUCTION **c25**
Peter M. Molton and Clayton Clarke (Florida Agricultural and Mechanical Univ., Tallahassee.) *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 19-28 (For primary document see N90-24350 18-23)
(Contract DE-AC06-76RL-01830)
Avail: NTIS HC A09/MF A02 CSCL 07D

Electrochemical Oxidation (ECO) offers promise as a low-temperature, atmospheric pressure method for safe destruction of hazardous organic chemical wastes in water. Anode materials tend to suffer corrosion in the intensely oxidizing environment of the ECO cell. There is a need for cheaper, more resistant materials. In this experiment, a system is described for testing anode materials, with examples of several common anodes such as stainless steel, graphite, and platinized titanium. The ECO system is simple and safe to operate and the experiment can easily be expanded in scope to study the effects of different solutions, temperatures, and organic materials. Author

N90-24355*# University of Western Michigan, Kalamazoo. Dept. of Mechanical Engineering.
A SIMPLE DEMONSTRATION OF CORROSION CELLS **c26**
Philip J. Guichelaar and Molly W. Williams *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 29-36 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11F

The objective is to reinforce and enhance the understanding of galvanic cells, anode cathode reactions and polarization phenomena. Complete instructions are given for laboratory demonstration to be performed by students. Author

N90-24356*# Purdue Univ., West Lafayette, IN.
THERMAL CONDUCTIVITY OF METALS **c26**
Sayyed M. Kazem *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 37-43 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11F

The objective is to familiarize students with steady and unsteady heat transfer by conduction and with the effect of thermal conductivity upon temperature distribution through a homogeneous substance. The elementary heat conduction experiment presented is designed for associate degree technology students in a simple manner to enhance their intuition and to clarify many confusing concepts such as temperature, thermal energy, thermal conductivity, heat, transient and steady flows. The equipment set is safe, small, portable (10 kg) and relatively cheap (about $1200): the electric hot plate 2 kg (4.4 lb) for $175: the 24 channel selector and Thermocouple Digital Readout (Trendicator) 4.5 kg (10 lb) for about $1000; the three metal specimens (each of 2.5 cm diameter and 11 cm length), base plate and the bucket all about 3 kg (7 lb) for about $25. The experiment may take from 60 to 70 minutes. Although the hot plate surface temperature could be set from 90 to 370 C (maximum of 750 watts) it is a good practice to work with temperatures of 180 to 200 C (about 400 watts). They may experiment in squads of 2, 3 or even 4, or the instructor may demonstrate it for the whole class. Author

N90-24357*# San Jose State Univ., CA. Div. of Technology.
THE ASSESSMENT OF METAL FIBER REINFORCED POLYMERIC COMPOSITES **c24**
Wenchiang R. Chung *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 45-51 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11D

Because of their low cost, excellent electrical conductivity, high specific strength (strength/density), and high specific modulus (modulus/density) short metal fiber reinforced composites have enjoyed a widespread use in many critical applications such as automotive industry, aircraft manufacturing, national defense, and space technology. However, little data has been found in the study of short metal fibrous composites. Optimum fiber concentration in a resin matrix and fiber aspect ratio (length-to-diameter ratio) are often not available to a user. Stress concentration at short fiber ends is the other concern when the composite is applied to a load-bearing application. Fracture in such composites where the damage will be initiated or accumulated is usually difficult to be determined. An experimental investigation is therefore carefully designed and undertaken to systematically evaluate the mechanical properties as well as electrical properties. Inconel 601 (nickel based) metal fiber with a diameter of eight microns is used to reinforce commercially available thermoset polyester resin. Mechanical testing such as tensile, impact, and flexure tests along with electrical conductivity measurements is conducted to study the feasibility of using such composites. The advantages and limitations of applying chopped metal fiber reinforced polymeric composites are also discussed. Author

N90-24358*# East Carolina Univ., Greenville, NC. Dept. of Construction Management.
EXPERIMENTAL DETERMINATION OF MATERIAL DAMPING USING VIBRATION ANALYZER **c39**
Mostafiz R. Chowdhury and Farida Chowdhury *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials and Science Technology May 1990 p 53-63 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 20K

Structural damping is an important dynamic characteristic of engineering materials that helps to damp vibrations by reducing their amplitudes. In this investigation, an experimental method is illustrated to determine the damping characteristics of engineering materials using a dual channel Fast Fourier Transform (FFT) analyzer. A portable Compaq III computer which houses the analyzer, is used to collect the dynamic responses of three metal rods. Time-domain information is analyzed to obtain the logarithmic decrement of their damping. The damping coefficients are then compared to determine the variation of damping from material to material. The variations of damping from one point to another of the same material, due to a fixed point excitation, and the variable damping at a fixed point due to excitation at different points, are also demonstrated. Author

N90-24359*# Purdue Univ., West Lafayette, IN.
RECYCLING WASTE-PAPER **c27**
Edward L. Widener *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 65-69 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11C

Perhaps 80 percent of papermaking energy is expended in chemical pulping of vegetable cellulose, a natural polymer. Commercial supplies of wood, bagasse, cotton and flax are valued as renewable resources and bio-mass assets; however, few

enterprises will salvage waste-paper and cardboard from their trash. A basic experiment in the Materials Lab uses simple equipment to make crude handsheets. Students learn to classify secondary fibers, identify contraries, and estimate earnings. Author

N90-24360*# Purdue Univ., Elkhart, IN.
PIEZOELECTRIC AND PYROELECTRIC EFFECTS OF A CRYSTALLINE POLYMER **c27**
Nikhil K. Kundu and Malay Kundu (Adams, John High School, South Bend, IN) *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 71-76 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11C

Polyvinylidene flouride (PVDF) is a crystalline polymer to both piezoelectric and pyroelectric nature. Piezoelectricity produces electrical signals when mechanically deformed, and pyroelectricity is the electrical polarization induced by thermal absorption in crystals. To demonstrate the piezoelectric effect PVDF is subjected to impact loads which produce electrical charges proportional to mechanical stresses. A heat source was used to demonstrate the pyroelectric nature of PVDF. The rise in temperature due to absorbed energy by the polymer produces electrical output. The qualitative test results obtained are graphically reproduced. Author

N90-24361*# West Texas State Univ., Canyon. Dept. of Engineering Technology.
USING TEMPLATE/HOTWIRE CUTTING TO DEMONSTRATE MOLDLESS COMPOSITE FABRICATION **c24**
J. Mario Coleman *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 77-88 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11D

The objective of this experiment is to provide a simple, inexpensive composite fabrication technique which can be easily performed with a minimum of equipment and facilities. This process eliminates expensive female molds and uses only male molds which are easily formed from foam blocks. Once the mold is shaped, it is covered with fiberglass and becomes a structural component of the product. Author

N90-24362*# University of Southern Colorado, Pueblo.
RUBBERLIKE ELASTICITY EXPERIMENT **c27**
Richard Greet and Robert Cobaugh *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 89-91 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11C

Four rubber erasers from the campus bookstore, two green and two white, have been cut to have identical dimensions. These are loaded in compression with a mechanical test machine capable of applying cyclic loads and providing output to an X-Y plotter. The anelastic behavior of rubber as well as the relative stiffnesses of composite materials loaded transversely and longitudinally may be demonstrated to beginning students or used as input for computer analysis by students. Author

N90-24363*# Purdue Univ., Elkhart, IN.
THE EFFECT OF THERMAL DAMAGE ON THE MECHANICAL PROPERTIES OF POLYMER REGRINDS **c27**
Nikhil K. Kundu *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 93-99 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11C

Reprocessed polymers are subjected to high processing temperatures that result in the breakdown of molecular chains and changes in the molecular structures. These phenomena are reflected in the mechanical properties of materials. Practically every regrind is seen as a new material. These experiments deal with the molding, regrinding, and reprocessing of test specimens for the study of their mechanical properties. The comparative test data from each recycled material would give students an insight of the molecular structures and property degradation. Three important rheological and mechanical properties such as melt flow, impact strength, and flexural strength are to be determined. These properties play key roles in the selection of engineering materials. The material selected for demonstration was Makrolon 3000L, a polycarbonate thermoplastic from Bayer AG. The thermal degradation due to repeated processing is reflected in the decrease in molecular weight and breakdown of molecular chains causing increase in melt flow. The Izod-impact resistance and the flexural strength deteriorate gradually. Author

N90-24364*# Wentworth Inst., Boston, MA.
DEMO OF THREE WAYS TO USE A COMPUTER TO ASSIST IN LAB **c61**
J. P. Neville *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 101-104 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 09B

The objective is to help the slow learner and students with a language problem, or to challenge the advanced student. Technology has advanced to the point where images generated on a computer can easily be recorded on a VCR and used as a video tutorial. This transfer can be as simple as pointing a video camera at the screen and recording the image. For more clarity and professional results, a board may be inserted into a computer which will convert the signals directly to the TV standard. Using a computer program that generates movies one can animate various principles which would normally be impossible to show or would require time-lapse photography. For example, you might show the change in shape of grains as a piece of metal is cold worked and then show the recrystallization and grain growth as heat is applied. More imaginative titles and graphics are also possible using this technique. Remedial help may also be offered via computer to those who find a specific concept difficult. A printout of specific data, details of the theory or equipment set-up can be offered. Programs are now available that will help as well as test the student in specific areas so that a Keller type approach can be used with each student to insure each knows the subject before going on to the next topic. A computer can serve as an information source and contain the microstructures, physical data and availability of each material tested in the lab. With this source present unknowns can be evaluated and various tests simulated to create a simple or complex case study lab assignment. Author

N90-24365*# Science High School, Newark, NJ.
THE MAGNETIZATION PROCESS: HYSTERESIS **c70**
Richard Balsamel *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 105-113 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 20C

The magnetization process, hysteresis (the difference in the path of magnetization for an increasing and decreasing magnetic field), hysteresis loops, and hard magnetic materials are discussed. The fabrication of classroom projects for demonstrating hysteresis and the hysteresis of common magnetic materials is described in detail. Author

N90-24366*# Anne Arundel Community Coll., Arnold, MD.
TENSILE AND SHEAR STRENGTH OF ADHESIVES **c27**
Kenneth A. Stibolt *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 115-117 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11C

This experiment is conducted in a freshman-level course: Introduction to Engineering Materials. There are no prerequisites for the course although students should have some knowledge of

basic algebra. The objectives are to tension and shear test adhesives and to determine the tensile and shear properties of adhesives. Details of equipment of procedure are given. Author

N90-24367*# Iowa State Univ. of Science and Technology, Ames.
EXPERIMENTS AND OTHER METHODS FOR DEVELOPING EXPERTISE WITH DESIGN OF EXPERIMENTS IN A CLASSROOM SETTING **c80**
John W. Patterson *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 119-131 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 05D

The only way to gain genuine expertise in Statistical Process Control (SPC) and the design of experiments (DOX) is with repeated practice, but not on canned problems with dead data sets. Rather, one must negotiate a wide variety of problems each with its own peculiarities and its own constantly changing data. The problems should not be of the type for which there is a single, well-defined answer that can be looked up in a fraternity file or in some text. The problems should match as closely as possible the open-ended types for which there is always an abundance of uncertainty. These are the only kinds that arise in real research, whether that be basic research in academe or engineering research in industry. To gain this kind of experience, either as a professional consultant or as an industrial employee, takes years. Vast amounts of money, not to mention careers, must be put at risk. The purpose here is to outline some realistic simulation-type lab exercises that are so simple and inexpensive to run that the students can repeat them as often as desired at virtually no cost. Simulations also allow the instructor to design problems whose outcomes are as noisy as desired but still predictable within limits. Also the instructor and the students can learn a great deal more from the postmortum conducted after the exercise is completed. One never knows for sure what the true data should have been when dealing only with real life experiments. To add a bit more realism to the exercises, it is sometimes desirable to make the students pay for each experimental result from a make-believe budget allocation for the problem. Author

N90-24368*# San Jose State Univ., CA.
MANUAL AND COMPUTER-AIDED MATERIALS SELECTION FOR INDUSTRIAL PRODUCTION: AN EXERCISE IN DECISION MAKING **c61**
Seth P. Bates *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 133-139 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 09B

Students are introduced to methods and concepts for systematic selection and evaluation of materials which are to be used to manufacture specific products in industry. For this laboratory exercise, students are asked to work in groups to identify and describe a product, then to proceed through the process to select a list of three candidates to make the item from. The exercise draws on knowledge of mechanical, physical, and chemical properties, common materials test techniques, and resource management skills in finding and assessing property data. A very important part of the exercise is the students' introduction to decision making algorithms, and learning how to apply them to a complex decision making process. Author

N90-24369*# Norfolk State Univ., VA. School of Technology.
PREPARING TECHNICIANS FOR ENGINEERING MATERIALS TECHNOLOGY
James A. Jacobs and Carlton H. Metzloff (Erie Community Coll., Buffalo, NY.) *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 143-150 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 07A

A long held principle is that for every engineer and scientist there is a need for ten technicians to maximize the efficiency of the technology team for meeting needs of industry and government. Developing an adequate supply of technicians to meet the requirements of the materials related industry will be a challenge and difficult to accomplish. A variety of agencies feel the need and wish to support development of engineering materials technology programs. In a joint effort among Battelle Laboratories, the Department of Energy (DOE) and Northwest College and University Association for Science (NORCUS), the development of an engineering materials technology program for vocational programs and community colleges for the Pacific Northwest Region was recently completed. This effort has implications for a national model. The model Associate of Applied Science degree in Engineering Materials Technology shown provides a general structure. It purposely has course titles which need delimiting while also including a core of courses necessary to develop cognitive, affective and psychomotor skills with the underlining principles of math, science and technology so students have job entry skills, and so that students can learn about and adapt to evolving technology. Author

N90-24370*# Ford Motor Co., Dearborn, MI.
FUTURE AUTOMOTIVE MATERIALS: EVOLUTION OR REVOLUTION
P. Beardmore *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 151-170 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 07A

An exciting era is evolving in the application of new materials technologies to automotive applications. The desire on the part of the automobile industry to completely satisfy the customers while concurrently meeting increasing demands and regulations for stringent emission control and fuel efficiency is opening a plethora of opportunities for new materials. In many cases, materials solutions are the only mechanisms for resolving some of the upcoming issues. The materials scientist and engineer will therefore have a primary role to play and will assume a position of significance hithertofore unseen in the automobile industry. The nature of the industry dictates that changes are primarily evolutionary with respect to chronology but nevertheless some of the future material changes will be revolutionary in nature. This presentation will treat three primary systems of the vehicle separately, based on the different materials approaches which will be adopted. These areas are: (1) skin panels, (2) structures, and (3) powertrains. The competition between a variety of new materials in these 3 systems will be discussed in detail with the various tradeoffs being outlined. Amongst the more prominent of the new breed of materials will be new steel technologies, structural plastics (FRP), aluminum alloys (conventional and rapidly solidified), titanium alloys, metal matrix composites and smart materials (electrorheological fluids, etc.). The pace of development and application is accelerating rapidly and the impetus is likely to increase. Author

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials*.

N90-24371 Purdue Univ., West Lafayette, IN.
AN ELASTIC/VISCOPLASTIC CONSTITUTIVE MODEL FOR FIBER-REINFORCED THERMOPLASTIC COMPOSITES Ph.D. Thesis
Thomas Scott Gates 1989 159 p
Avail: Univ. Microfilms Order No. DA9008615

A constitutive model to describe the rate dependent stress/strain behavior of fiber reinforced thermoplastic composites is presented. Formulations are given for anisotropic elasticity, quasistatic plasticity, and time dependent viscoplasticity. The generalized multiaxial case along with the uniaxial case for orthotropic materials are derived. Verification of these theories is

accomplished by comparison with experimental data. Procedures required to generate this data along with the necessary material constants are explained, and the use of these constants in the constitutive equations is discussed. Dissert. Abstr.

N90-24372 Delaware Univ., Newark.
STRESS FIELDS IN COMPOSITE MATERIALS BY MEANS OF A NONCLASSICAL APPROACH Ph.D. Thesis
Emin Selcuk Ardic 1989 107 p
Avail: Univ. Microfilms Order No. DA9010390

A method is developed to determine the stress fields in composite materials. Far-field strains which are assumed to be measured or calculated by using the classical methods, are considered as known inputs. By using an elasticity analysis the interface strains of the different materials in the composite are determined. Nonlocal elasticity is taken as a basis, and the long-range effects of the different material regions on each other are expressed as the heterogeneity effects. Since the far-field strains, calculated by using anisotropic elasticity, are used as inputs, the anisotropy is taken into account in addition to inhomogeneity. Therefore separate stress fields in the different materials of the composites are determined without ignoring either heterogeneity or anisotropy. Different versions of the method are developed for a few typical composite structures. The method is presented for a laminated composited, a three-dimensional continuous fiber-reinforced composite, a thick section and a two-dimensional crack problem. In the laminated composite case the results are compared to a classical solution and the exact laminate solution, and it is seen that the nonclassical method agrees with the exact solution very well. In the other cases the sample results obtained by using the nonclassical method developed in this study, are compared to those of the classical solutions. The method is developed and presented for a few basic composite structures; several suggestions are made for more complicated and realistic cases future studies. Dissert. Abstr.

N90-24373# Oak Ridge National Lab., TN.
HIGH TEMPERATURE OXIDATION OF Ni3Al COMPOSITES
P. F. Tortorelli, J. H. DeVan, C. G. McKamey, and M. Howell 1990 6 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract DE-AC05-84OR-21400)
(DE90-010145; CONF-900466-17) Avail: NTIS HC A02/MF A01

As part of an effort to develop oxidation-resistant metal matrix composites, the influence of reinforcement materials on the oxidation of Ni3Al was studied. Thermogravimetric measurements and microstructural analyses were used to determine the 800 C oxidation behavior of Ni3Al and composites based on this material. The presence of fiber (Al2O3)- or particle (TiN or TiC)-reinforcement material in the Ni3Al increased susceptibility to oxidation as measured by the amount of reacted material, rate constants, and/or extent of internal attack. The orientation of fibers with respect to the free surfaces was found to affect the oxidation behavior by providing, in certain cases, reactive paths along the fiber-matrix interface that led to significant internal penetration. The results suggest that the choice of reinforcement material and the method of materials processing will be important considerations in the design of oxidation-resistant Ni3Al composites. However, ways to minimize the detrimental influence of the reinforcement material on oxidation resistance often conflict with requirements for obtaining attractive mechanical and physical properties of the composite. DOE

N90-24374# Aerospatiale, Bordeaux (France).
AECM3: ACOUSTIC EMISSION CONDITIONS FOR FAILURE PREDICTION OF WINDING CARBON STRUCTURES
C. LeFloch and S. Beziers Jul. 1989 7 p
(Rept-892-430-115; ETN-90-96646) Avail: NTIS HC A02/MF A01

Preliminary results of a study on the prediction by Acoustic Emission (AE) of the pressure burst of a composite pressurant tank are presented. The prediction is realized with a criterion in relation with the pressure level and defined with AE measurements. The experimental study concerns winding structures with IM6 fiber embedded in an expoxy matrix. Results are shown graphically. Unresolved questions are given. ESA

N90-24375# Aerospatiale Aquitaine, Saint-Medard en Jalles (France).
STATE OF THE ART AND FUTURE PROSPECTS FOR HIGH TEMPERATURE COMPOSITES
Jean F. Jamet 1989 11 p Presented at ECCM-3, Bordeaux, France, 20-23 Mar. 1989
(Rept-892-430-125; ETN-90-96656) Avail: NTIS HC A03/MF A01

An analysis of the microstructural rupture of carbon and ceramic composites and the evolution of models describing this rupture is made. The main aspects of carbon composites protection and ceramic composites manufacturing are studied in order to emphasize the rules governing the relations between microstructure and rupture and the consequences upon architecture, processing and using methods. ESA

N90-24376# Argonne National Lab., IL. Materials Science Div.
FRACTURE TOUGHNESS AND SOLID-PARTICLE EROSION OF CERAMIC-MATRIX WHISKER-REINFORCED COMPOSITES
J. L. Routbort, Kenneth C. Goretta, C.-Y. Chu, and J. P. Singh Feb. 1990 14 p Presented at the Conference on the Tribology of Composite Materials, Oak Ridge, TN, 1-3 May 1990
(Contract W-31-109-eng-38)
(DE90-009713; CONF-900513-1) Avail: NTIS HC A03/MF A01

Fracture toughness and solid-particle erosion resistance of several ceramic whisker-reinforced ceramic matrix composites have been measured. Systems include Al(sub 2)O(sub 3) (plus) SiC(w), Si(sub 3)N(sub 4) (plus) Si(sub 3)N(sub 4)(w), Si(sub 3)N(sub 4) (plus) SiC(w) and Y(sub 2)O(sub 3)-stabilized ZrO(sub 2) (pius) Al(sub 2)O(sub 3)(w). Erosion has been investigated at room temperature for erodents of varying hardness, impact angles between 15 and 90(degrees), and velocities from 40 to 150 m/s. Results indicate that some toughening mechanisms are beneficial, whereas others are detrimental, to erosion resistance. Fabrication of the composites plays an important role in the erosion resistance. DOE

N90-24377# Los Alamos National Lab., NM.
Ta AND Nb REINFORCED MoSi2
David H. Carter and Patrick L. Martin (Rockwell International Science Center, Thousand Oaks, CA.) 11 Apr. 1990 9 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990 Revised
(Contract W-7405-eng-36)
(DE90-010596; LA-UR-90-1310; CONF-900466-24) Avail: NTIS HC A02/MF A01

MoSi2 matrix composites were recognized lately as potential materials for structural applications at elevated temperatures. Specifically, MoSi2 composites may exhibit useful properties at temperatures to 1400 C. Previous work improved the yield strength of MoSi2 at 1400 C by a factor of five through SiC whisker reinforcement. Current research is directed towards increasing the fracture toughness of MoSi2 through the addition of ductile phase reinforcements such as niobium and tantalum. The reaction between Nb and MoSi2 to form (Mo,Nb)5Si3 proceeds with faster kinetics at hot isostatic press temperatures as low as 1100 C when compared to the reaction between Ta and MoSi2 to form (Mo,Ta)5Si3. This reaction product exhibits very poor properties, as evidenced by crack propagation through this layer during fracture. The feasibility of hot working these composites to produce tailored microstructures is examined. DOE

N90-24378# Los Alamos National Lab., NM. Materials Science and Technology Div.
THE MECHANICAL PROPERTIES OF Cu/TiB2 MULTILAYER STRUCTURES
Kevin M. Hubbard, Soumendra Basu, Juha-Pekka Hirvonen, Thomas R. Jervis, and Michael Nastasi 1990 6 p Presented

at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract W-7405-eng-36)
(DE90-010608; LA-UR-90-1368; CONF-900466-22) Avail: NTIS HC A02/MF A01

We have investigated the hardness and tribological properties of Cu/TiB2 multilayer structures deposited on substrates of tempered martensitic steel. Films of Cu and TiB2 were also deposited as hardness standards. The wear properties of the films were found to be poor, because of lack of adhesion. However, the films do appear to have good fracture toughness. The hardness of the multilayer was 20 percent greater than that predicted by the law of mixtures applied to the reference standards and, when corrected for variations in substrate hardness, very nearly equal to that of the TiB2 film. Irradiation by 400 keV Ne-ions to doses of 1.0, 6.0, and 12 times 10 to the 15th power ion/sq cm results in a slight hardening of the multilayer. The structure was found to have excellent stability against radiation damage. DOE

N90-24379# Los Alamos National Lab., NM.
CHARACTERIZATION OF SOLID STATE BONDING BETWEEN COORS AD-999 ALUMINA AND NIOBIUM
M. G. Stout, M. L. Lovato, A. Geltmacher (Pennsylvania State Univ., University Park.), T. G. Zocco, and Thomas R. Jervis May 1990 14 p
(Contract W-7405-eng-36)
(DE90-010653; LA-11815-MS) Avail: NTIS HC A03/MF A01

A candidate model system was investigated for the study of bi-material fracture. The mechanical and microstructural properties of a polycrystalline alumina (Coors AD-999)/pure polycrystal niobium solid-state bond were examined. Samples were bonded in vacuum at 160 C for 15 min, 30 min, 1 hour, under pressures of 10.5 and 15.5 MPa. The bonds were tested in tension, and a maximum strength of 87.8 MPa was found. The differences in strength measured for different bonding conditions were attributed to artifacts of the tensile test procedure rather than to differences in bonding time or pressure. The polycrystal Al2O3/Nb interface was studied with nanohardness, scanning electron microscopy and transmission electron microscopy techniques, and concluded that we could not measure a finite-width reaction zone between the Al2O3 and niobium. The sharpness of the interface band was greater than the resolution of the techniques we used to measure its width. The plastic properties of the pure niobium were measured in addition to the interface characteristics. It was found that the niobium was very strain-rate sensitive, with a rate sensitivity exponent of m is approximately 0.035 and a work-hardening exponent of 1/n is approximately 0.017. On the basis of this study it was concluded that this Al2O3/Nb system would be appropriate for experimental fracture work. DOE

N90-24380# Applied Research Lab., State College, PA.
DEVELOPMENT OF DAMPED METAL MATRIX COMPOSITES FOR ADVANCED STRUCTURAL APPLICATIONS
Clark A. Updike and Ram B. Bhagat Apr. 1990 98 p
(Contract N00024-85-C-6041)
(AD-A219864; ARL/PSU/TR-90-004) Avail: NTIS HC A05/MF A01 CSCL 11/4

The development of damped metal matrix composite structures for advanced applications has been investigated by the use of two different approaches: (1) the development of metal matrix composites with high intrinsic damping compared to that of the matrix material, and (2) the development of coated metal matrix composites with high structural damping compared to that of the composite substrates. The two different approaches are analyzed in terms of their potential for improved damping and feasibility for structural applications. Damping was measured by the transverse vibration of free-free beams using the bandwidth technique by a laser vibrometer under ambient conditions. The damping measurements were made over a wide range of frequencies, (.7 kHz to 25.6 kHz) at low strain amplitudes (10 to the -10 power to 10 to the -7 power). Materials investigated for their tensile stiffness, strength, and damping performance include mechanically alloyed (MA) Aluminum-Magnesium, SiC(p)/Aluminum-Copper (MA), SiC(p)/Al, Al2O3(p)/Al, SiC(W)/Al, planar random Gr/Al, unidirectional Gr/Al and unidirectional SiC(Nicalon)/Al composites. The effects of coatings of high damping metals (nitinol and incramute) on 6061-T6 Al and Al2O3(p)/Al substrates have also been studied. The Al-Mg (MA), SiC(p)/Al (MA), SiC(W)/Al and the Al2O3(p)/Al composites show no significant improvement in damping compared with that of the 6061-T6 Al. GRA

N90-24381# Case Western Reserve Univ., Cleveland, OH. Dept. of Macromolecular Science.
PROCEEDINGS OF BIOSTRUCTURES AS COMPOSITE MATERIALS ARO WORKSHOP Final Report, 1 Jun. 1989 - 31 May 1990
Eric Baer and Igbal Ahmad Mar. 1990 215 p Workshop held in Cleveland, OH, 23-25 Oct. 1989
(Contract DAAL03-89-G-0075)
(AD-A220262; ARO-26892.1-MS-CF) Avail: NTIS HC A10/MF A02 CSCL 11/4

Realizing the opportunities that the studies of biosystems can offer to materials scientists and engineers, and the general lack of communication between the materials scientists and the biologists, the Army Research Office organized this workshop in which active workers in the field of biomechanics and biophysics as well as materials scientists participated. The focus was on the hierarchical structures in biosystems. In addition to identifying the fundamental structural design-property relationships all the way from molecular to the engineering systems scale, participants recommended a number of areas for future research necessary to develop radically new materials and systems, in which the design principle used in nature can be utilized and perhaps even mimicked. GRA

N90-24382*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INFLUENCE OF INTERFACIAL SHEAR STRENGTH ON THE MECHANICAL PROPERTIES OF SiC FIBER REINFORCED REACTION-BONDED SILICON NITRIDE MATRIX COMPOSITES
Ramakrishna T. Bhatt (Army Aviation Systems Command, Cleveland, OH.) 1990 14 p Presented at the Advanced Metal and Ceramic Material Composites Symposium, Anaheim, CA, 23-27 Feb. 1990; sponsored by the Metallurgical Society
(NASA-TM-102462; E-5250; NAS 1.15:102462; AVSCOM-TR-90-C-003) Avail: NTIS HC A03/MF A01 CSCL 11D

The influence of fiber/matrix interface microstructure and interfacial shear strength on the mechanical properties of a fiber-reinforced ceramic composite was evaluated. The composite consisted of approximately 30 vol percent uniaxially aligned 142 microns diameter SiC fibers (Textron SCS-6) in a reaction-bonded Si3N4 matrix (SiC/RBSN). The interface microstructure was varied by controlling the composite fabrication conditions and by heat treating the composite in an oxidizing environment. Interfacial shear strength was determined by the matrix crack spacing method. The results of microstructural examination indicate that the carbon-rich coating provided with the as-produced SiC fibers was stable in composites fabricated at 1200 C in a nitrogen or in a nitrogen plus 4 percent hydrogen mixture for 40 hr. However this coating degraded in composites fabricated at 1350 C in N2 + 4 percent H2 for 40 and 72 hr and also in composites heat treated in an oxidizing environment at 600 C for 100 hr after fabrication at 1200 C in a nitrogen. It was determined that degradation occurred by carbon removal which in turn had a strong influence on interfacial shear strength and other mechanical properties. Specifically, as the carbon coating was removed, the composite interfacial shear strength, primary elastic modulus, first matrix cracking stress, and ultimate tensile strength decreased, but the first matrix cracking strain remained nearly the same. Author

N90-24383*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
METAL MATRIX COMPOSITES MICROFRACTURE: COMPUTATIONAL SIMULATION
Subodh K. Mital, John J. Caruso, and Christos C. Chamis 1990

14 p Proposed for presentation at the Symposium on Computational Technology for Flight Vehicles, Washington, DC, 5-7 Nov. 1990; cosponsored by NASA and George Washington Univ.
(NASA Order C-99066-G)
(NASA-TM-103153; ICOMP-90-14; E-5514; NAS 1.15:103153)
Avail: NTIS HC A03/MF A01 CSCL 11D

Fiber/matrix fracture and fiber-matrix interface debonding in a metal matrix composite (MMC) are computationally simulated. These simulations are part of a research activity to develop computational methods for microfracture, microfracture propagation and fracture toughness of the metal matrix composites. The three-dimensional finite element model used in the simulation consists of a group of nine unidirectional fibers in three by three unit cell array of SiC/Ti15 metal matrix composite with a fiber volume ration of 0.35. This computational procedure is used to predict the fracture process and establish the hierarchy of fracture modes based on strain energy release rate. It is also used to predict stress redistribution to surrounding matrix-fibers due to initial and progressive fracture of fiber/matrix and due to debonding of fiber-matrix interface. Microfracture results for various loading cases such as longitudinal, transverse, shear and bending are presented and discussed. Step-by-step procedures are outlined to evaluate composite microfracture for a given composite system. Author

N90-24384*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SIMPLIFIED DESIGN PROCEDURES FOR FIBER COMPOSITE STRUCTURAL COMPONENTS/JOINTS
P. L. N. Murthy and Christos C. Chamis 1990 23 p Presented at the Indo-US Workshop on Composite Materials for Aerospace Applications, Bangalore, India, 23-27 Jul. 1990; sponsored by Indian Inst. of Science
(NASA-TM-103113; E-5392; NAS 1.15:103113) Avail: NTIS HC A03/MF A01 CSCL 11D

Simplified step-by-step design procedures are summarized, which are suitable for the preliminary design of composite structural components such as panels (laminates) and composite built-up structures (box beams). Similar procedures are also summarized for the preliminary design of composite bolted and adhesively bonded joints. The summary is presented in terms of sample design cases complemented with typical results. Guidelines are provided which can be used in the design selection process of composite structural components/joints. Also, procedures to account for cyclic loads, hygrothermal effects and lamination residual stresses are included. Author

N90-24385# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
LIMITS TO TODAY'S COMPOSITES: CHANCES FOR TOMORROW'S DEVELOPMENTS
H. Kellerer, J. Brandt, R. Meistring, and R. Rauh 1989 55 p
(MBB-Z-0287-89-PUB; ETN-90-96971) Avail: NTIS HC A04/MF A01

The factors which limit the use of high performance composites in aerospace applications are discussed. The composite materials considered are carbon fiber reinforced carbon, aluminum matrix composites and carbon fiber reinforced plastics. The different possible fiber-matrix possibilities are discussed. The mechanical behavior of the fibers is investigated. The results of shear and fracture tests on different composite materials are presented. Impregnation techniques are described. Cost factors in the production and performance of composite materials are discussed. Extensive use of composite materials in areas other than aerospace is predicted. ESA

N90-24386# Oak Ridge National Lab., TN. Metals and Ceramics Div.
ELECTRON MICROSCOPY OF INTERFACES IN SILICON CARBIDE WHISKER-REINFORCED ALUMINA COMPOSITES
K. B. Alexander, P. Angelini, and P. F. Becher 1990 7 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract DE-AC05-84OR-21400)
(DE90-010439; CONF-900466-35) Avail: NTIS HC A02/MF A01

Knowledge about the nature of interfaces between SiC whiskers and alumina matrices is critical to understanding the mechanical behavior of these types of composites. The fracture toughness, in particular, is strongly influenced by the bond characteristics of this interface. Previous results have shown that oxidizing the whiskers in air prior to composite fabrication by vacuum hot-pressing results in composites which have lower toughness compared to those made with whiskers in the as-received condition. This investigation focusses on the effects of oxidizing and reducing surface treatments on the whiskers themselves and on the whisker-matrix interface. High resolution electron microscopy (HREM) was used to characterize the morphology and the amount of amorphous phase at the whisker-matrix interface, as well as the crystallography and topography of the interface. The present results indicate that the characteristics of the whisker/matrix interface may not be directly related to the initial whisker surface chemistry. Surprisingly, the thickest thermally-grown oxide layer resulted in the thinnest amorphous film at the SiC/Al2O3 interface. DOE

N90-24387# Idaho National Engineering Lab., Idaho Falls.
A PARTICLE-LEVEL NUMERICAL SIMULATION OF THE DYNAMIC CONSOLIDATION OF A METAL MATRIX COMPOSITE MATERIAL
R. L. Williamson and R. N. Wright 1989 5 p Presented at the American Physical Society Topical Conference on Shock Compression of Condensed Matter, Albuquerque, NM, 14-17 Aug. 1989
(Contract DE-AC07-76ID-01570)
(DE90-010950; EGG-M-89144; CONF-890812-66) Avail: NTIS HC A01/MF A01

Dynamic consolidation of a SiC fiber reinforced aluminum matrix composite is simulated using a particle-level numerical model. Simulation results are compared with the microstructure of a composite formed using a plate impact to consolidate a close-packed array of aluminum wires containing SiC fibers of the appropriate diameter to fill in the interstices approximating the geometry of the model. With respect to the observed deformation and the location and extent of melting of the aluminum wires, the simulation predictions are in good agreement with the experiment. DOE

N90-24388# Idaho National Engineering Lab., Idaho Falls.
METAL MATRIX COMPOSITES FROM DYNAMIC CONSOLIDATION OF POWDER MIXTURES
G. E. Korth, R. L. Williamson, and B. H. Rabin 1989 4 p Presented at the American Physical Society Topical Conference on Shock Compression of Condensed Matter, Albuquerque, NM, 14-17 Aug. 1989
(Contract DE-AC07-76ID-01570)
(DE90-010951; EGG-M-89160; CONF-890812-67) Avail: NTIS HC A01/MF A01

Mixtures of 2124 aluminum alloy and silicon carbide powders were dynamically consolidated using explosives. This process results in a fully dense product and has the potential of becoming an economical method of producing metal matrix composites, especially where undesirable reactions would normally occur between the metal and ceramic reinforcement. With the correct processing parameters, the aluminum powder plastically deforms to form a continuous matrix with minimum interaction with SiC. Microstructure and mechanical properties of the composite are presented. Numerical simulations were performed to better understand the consolidation process and determine test parameters difficult to obtain by experimentation. DOE

N90-24389# Oak Ridge National Lab., TN. Metals and Ceramics Div.
FRICTION AND WEAR OF WHISKER-REINFORCED CERAMIC COMPOSITE BODIES
C. S. Yust 1990 20 p Presented at the ASM International

Conference: Tribology of Composites, Oak Ridge, TN, 30 Apr. 1990
(Contract DE-AC05-84OR-21400)
(DE90-011313; CONF-9004201-1) Avail: NTIS HC A03/MF A01

An overview of the wear behavior of such a recent material development as whisker-reinforced ceramics will necessarily depend on limited sources. In fact, the literature contains very few references to wear studies in materials of this type. Whisker composites are an emerging material and it could hardly be expected that their behavior would be well characterized at this time, particularly with regard to wear behavior. Results of whisker composite wear studies which were performed at ORNL were summarized, as have relevant published data. The results presented, however, do more to indicate the need for additional work than to offer a complete body of knowledge. The results contained within this proceedings may prove to be one of the most concentrated collections of information to date on this topic. A conclusion which may be drawn by this overview is that wear behavior in whisker-reinforced ceramics can be complex and requires careful examination. The results indicate that the increased strength and fracture toughness produced by the inclusion of whiskers in ceramics may be offset by the introduction of phase interfaces subject to the action of dynamic stress states. Examples were presented of the well-known transition from mild to severe wear which is so characteristic not only of the wear of ceramics but of other materials, as well. Most ceramic wear testing to date indicates that unlubricated use of ceramics as machine components is not likely to be successful, except under very mild contact conditions. DOE

N90-24390# Oak Ridge National Lab., TN. Metals and Ceramics Div.
MECHANICAL PROPERTY CHARACTERIZATION OF FIBER-REINFORCED SiC MATRIX COMPOSITES
D. P. Stinton, R. A. Lowden, and R. H. Krabill 1990 14 p Presented at the 4th Conference on Fossil Energy Materials, Oak Ridge, TN, 15-17 May 1990
(Contract DE-AC05-84OR-21400)
(DE90-011316; CONF-900546-3) Avail: NTIS HC A03/MF A01

Mechanical properties of Nicalon-fiber-reinforced silicon carbide (SiC) matrix composites fabricated by a forced chemical vapor infiltration (CVI) process have been measured and compared with properties of composites fabricated by a conventional isothermal process. The mechanical properties are nearly identical for composites fabricated by the two processes provided that hot-face temperatures less than 1200 C are used for the forced CVI process. Composites reinforced with more stable Tyranno fibers were fabricated by forced CVI and exhibited room temperature mechanical properties similar to those of Nicalon-reinforced composites and improved high-temperature strengths. DOE

N90-24357*# San Jose State Univ., CA. Div. of Technology.
THE ASSESSMENT OF METAL FIBER REINFORCED POLYMERIC COMPOSITES
Wenchiang R. Chung *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 45-51 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11D

N90-24361*# West Texas State Univ., Canyon. Dept. of Engineering Technology.
USING TEMPLATE/HOTWIRE CUTTING TO DEMONSTRATE MOLDLESS COMPOSITE FABRICATION
J. Mario Coleman *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 77-88 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11D

N90-25049*# Wichita State Univ., KS. Dept. of Aerospace Engineering.
DEVELOPMENT OF A FINITE ELEMENT BASED DELAMINATION ANALYSIS FOR LAMINATES SUBJECT TO EXTENSION, BENDING, AND TORSION Abstract Only
Steven J. Hooper *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 81-83 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 11D

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N90-24391# Sandia National Labs., Albuquerque, NM.
RHEOLOGY AND MICROSTRUCTURE OF CONCENTRATED SUSPENSIONS
Lisa A. Mondy and Alan L. Graham (Los Alamos National Lab., NM.) 1990 12 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990 Sponsored in part by Air Force Astronautics Lab., Edwards AFB, CA
(Contracts DE-AC04-76DP-00789; W-7405-eng-36)
(DE90-009976; SAND-89-3131C; CONF-900466-9) Avail: NTIS HC A03/MF A01

We give an overview of some of the experiments currently underway to study the coupling of the microstructure and rheology of concentrated suspensions. Nuclear magnetic resonance imaging, real-time x ray radiography, and refractive index matching allow the viewing of particles in concentrated suspensions. Both shear flow experiments and falling ball rheometry are reviewed. In the slow flow of these suspensions of large, hard, particles in a viscous Newtonian fluid, colloidal forces are negligible and hydrodynamic forces dominate. Large local concentration changes are shown to occur rapidly in suspensions of uniform spheres subjected to flow between concentric rotating cylinders. Suspensions of spheres with a bimodal size distribution not only show similar phenomena, but also exhibit particle separation according to size. In addition, the large particles in the bimodal suspension migrate into ordered, concentric, cylindrical sheets, parallel to the axis of the cylinders. These sheets of particles rotate relative to each other. The particle migration and structure formation induced by this inhomogeneous shear flow is believed to be responsible for torque reductions and other anomalous behavior witnessed during the rheological testing of concentrated suspensions reported in the literature. Thus, suspensions may not always be characterized by a viscosity that is a scalar material property. Suspensions of fibers also show markedly different rheological properties when the particles are aligned by flow. Falling ball rheometry is shown to be an effective tool to determine the bulk viscosity of a suspension while only slightly influencing the microstructure. This is illustrated by showing that falling ball rheometry can isolate the effect of orientation on the viscosity of a suspension of fibers. DOE

N90-24392# State Univ. of New York, Buffalo. Dept. of Chemistry.
CHEMISTRY WITHIN MOLECULAR CLUSTERS
William R. Peifer, M. Todd Coolbaugh, and James F. Garvey 1990 14 p Submitted for publication
(Contract N00014-88-K-0493)
(AD-A219836; UBUFFALO/DC/90/TR-11) Avail: NTIS HC A03/MF A01 CSCL 20/5

This article reviews the cluster work for the past three years at SUNY. It is documented with illustrative examples, chemical reactions which only occur within the solvating environment of a cluster. GRA

N90-24393# State Univ. of New York, Buffalo. Dept. of Chemistry.
OBSERVATION OF A MAGIC NUMBER IN THE ION DISTRIBUTION OF ETHENE CLUSTERS
William R. Peifer, M. Todd Coolbaugh, and James F. Garvey 1990 21 p
(Contract N00014-88-K-0483)
(AD-A219837; UBUFFALO/DC/90/TR-10) Avail: NTIS HC A03/MF A01 CSCL 07/3

The study of chemical reactivity in gas phase van der Waals clusters has become an increasingly active research area. Much of this interest was generated by the position which clusters hold as an aggregate state of matter intermediate between the gas and condensed phases. In addition to this property, clusters provide the physical chemist with the ability to directly observe the effects of stepwise solvation on the course of a simple binary gas phase reaction. An understanding of the effects of solvation is critical in any attempt to forge a union between the disparate fields of gas and condensed phase (solution) chemistry. The observation of a magic number of n = 4 in the (C2H4)(n+) cluster ion distribution only under experimental conditions of low nozzle temperature or high stagnation pressure is presented. This result was not attributed to any special thermodynamic stability of the neutral or ionic cluster, and speculate that it is due to the formation of a C8H16(+) molecular ion. It is felt that this product cation is formed via a series of exoergic condensation reactions which occur within the parent ethene cluster ion. Also presented in this letter are pressure dependence data which are used to elucidate other competing reactive mechanisms. GRA

N90-24394# California Univ., Irvine. Dept. of Mechanical Engineering.
FUNDAMENTAL STUDIES ON SPRAY COMBUSTION AND TURBULENT COMBUSTION Final Report, 1 Nov. 1986 - 31 Oct. 1989
W. A. Sirignano, G. S. Samuelsen, R. H. Rangel, C.-H. Chiang, and B. E. Stapper 1 Jan. 1990 160 p
(Grant AF-AFOSR-0016-86; AF Proj. 2308)
(AD-A219840; AFOSR-90-0355TR) Avail: NTIS HC A08/MF A01 CSCL 21/2

Four major tasks are described: an atomization experiment, an atomization analysis, a turbulent reactive flow analysis, and a vaporizing droplet analysis. The atomization theoretical and experimental studies consider the nonlinear distortion of a planar liquid fuel stream. Various modes of surface instabilities are identified and analyzed in detail. Critical values of parameters related to surface tension, stream velocities, disturbance wavelength, stream densities, and liquid stream thickness are identified as the separation between stable and unstable interfaces. Measurements of the resulting spray characteristics are also presented. The analysis for turbulent reactive flows emphasizes molecular mixing and chemical reaction within a vortical structure. Isolated vortices are examined. The vortices are at the interface between two flows of different composition. Probability density functions (pdf) and concentration and velocity profiles are determined and compared to existing experimental data. Temporally-developing and spatially-developing mixing layers are simulated. Merging and pairing of vortices is shown to be the major entrainment mechanism. The larger values of the pdf on the high-speed-stream side of the simulated mixing layer agree with experiment but are shown to be caused by a velocity bias rather than by larger mixing rates. The study of vaporizing droplets involves Navier-Stokes solution for the axisymmetric flow around and within fuel droplets. GRA

N90-24395# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
NONLOCAL FREE ENERGY DENSITY FUNCTIONAL APPROXIMATIONS FOR THE ELECTRICAL DOUBLE LAYER; COMPARISON WITH MONTE CARLO RESULTS FOR 2:1 SALT
L. Mier-y-Teran, Zixiang Tang, Henry S. White, and H. T. Davis 10 Apr. 1990 27 p Subrnitted for publication Sponsored in part by NSF and Minnesota Supercomputer Inst.
(Contract N00014-87-K-0494)
(AD-A220911; TR-10-ONR) Avail: NTIS HC A03/MF A01 CSCL 07/4

Density profiles and mean electrostatic potentials are reported of a restricted primitive model double layer. Results for an asymmetric 2:1 salt, predicted by three different nonlocal free energy density functional approximations, are compared with Monte Carlo results and with those of Gouy-Chapman theory. Results for the diffuse layer potential are also compared with those of some recent theories of the double layer. The hard-sphere contribution to the free-energy functional is based on a nonlocal generic model functional proposed by Percus. The Carnahan-Starling equation of state was chosen to calculate the free energy of the homogeneous hard-sphere mixture which enters in the hard-sphere functional. The mean spherical approximation for a neutral bulk electrolyte is used to model the electrostatic part of the non-uniform ion-ion correlations present in the interface. For singly charged counterions the agreement between the density functional approximations applied here and the Monte Carlo data is excellent. For doubly charged counterions the agreement is very good at high concentrations, but differs from the MC results in several aspects at low concentrations. The density functional theories are successful in predicting the extremum of the diffuse-layer potential as a function of surface charge present in the simulations. GRA

N90-24396# Washington Univ., Seattle. Dept. of Chemistry.
USE OF AB INITIO THEORY IN STUDYING VARIOUS CHEMICAL SYSTEMS Ph.D. Thesis
Michael B. Coolidge 1990 143 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A220913; AD-E501211; AFIT/CI/CIA-90-006D) Avail: NTIS HC A07/MF A01 CSCL 07/4

Using ab initio calculations to supplement existing experimental data, a variety of chemical phenomena were investigated. These include: the effects of substituents on altering carbon-hydrogen and silicon-hydrogen bond strengths, the mode by which the empty orbital on boron alters the properties of an adjacent phosphorous atom, and the effect of substituents on the singlet-triplet energy gap in a non-Kekule molecule. It was found that substituents can alter the strength of carbon-hydrogen and silicon-hydrogen bonds through both pi delocalization and omega electron donation/withdrawal. The prediction was made that two BH2 groups cooperate and hence increase the calculated pi bond strength in diboryl phosphine. The strength of the carbonyl bond was shown to be largely responsible for reducing the singlet-triplet energy gap in oxyallyl to near degeneracy and in causing dimethyloxyallyl to have a predicted singlet electronic ground state. GRA

N90-24397# Defence Research Establishment Suffield, Ralston (Alberta).
RETENTION INDEX MONITORING OF VOLATILE ORGANIC COMPOUNDS USING THERMAL DESORPTION GAS CHROMATOGRAPHY
James R. Hancock and Gregory P. Peters Dec. 1989 30 p
(AD-A221117; DRES-SR-537) Avail: NTIS HC A03/MF A01 CSCL 07/4

Retention index monitoring using thermal desorption gas chromatographic analysis was developed as a method for the verification of compounds of chemical defence interest in environmental matrices. Gas chromatographic (GC) retention indices were determined by loading solid adsorbent packed sampling tubes initially with the target compounds and subsequently with a series on n-alkane probes. The resulting chromatographic performance and GC retention indices were shown to be independent of the tube loading method. A database of GC retention indices for chemical warfare agents and simulants was compiled and, in conjunction with simultaneous flame ionization and flame photometric detection, applied to the identification of triethyl phosphate, tributyl phosphate and diethyl malonate in water and soil samples. GRA

N90-24398# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Physical Metallurgy.
SURFACE AND INTERFACE STUDIES BY AUGER ELECTRON SPECTROSCOPY Ph.D. Thesis
Eero O. Ristolainen Oct. 1989 45 p
(ETN-90-96948) Avail: NTIS HC A03/MF A01

A characterization of the surface and interface properties of alkaline Earth thin films is presented. Zinc alloy coatings on hot-dipped galvanized steel sheet, and titanium and zirconium nitride ion-plated films are investigated. Scanning Auger microscopy, which combines surface analysis and profiling capabilities, is used in the characterization process. The high lateral resolution capability of the Auger microprobe technique gives it distinct advantages in the analysis of inhomogeneities in thin surface films and interfacial layers. Improvements in specimen preparation methods are described. ESA

N90-24399# Oak Ridge National Lab., TN. Chemical Technology Div.
IMPROVEMENTS IN MACRORETICULAR PARTICLES FOR ION-EXCHANGE AND GEL-PERMEATION CHROMATOGRAPHY
J. S. Watson 1990 14 p Presented at the Ion-Ex 1990, Cartrefle, England, 9-11 Jul. 1990
(Contract DE-AC05-84OR-21400)
(DE90-003717; CONF-900737-1) Avail: NTIS HC A03/MF A01

The effectiveness of chromatographic processes is often limited by the resistance to mass transfer into the exchanger particles. The likelihood of the exchange process being limited by particle diffusion resistance is especially high when one or both of the exchanging ions has a high molecular weight, and thus large molecular size and low mobility within the particles. Separation of ionic species from bioreactors is likely to involve such high molecular weight species and slow diffusion rates. Macroreticular particles are more effective in these applications because the larger species can diffuse more freely into the inner regions of the particles through large pores. The effects of small viscous flow rates through the larger pores of the macroreticular particle structure are examined to show how such flow can increase exchange rates. The importance of such flow is evaluated in terms of an effective diffusivity within the particle. The performance of an ion-exchange material can be affected strongly by the dimensions of its internal structure. The approach used to describe and evaluate the performance of ion-exchange materials with high molecular weight ions can be applied to macroreticular particles for separation of biological species and polymers by gel permeation. DOE

N90-24400# Lawrence Livermore National Lab., CA.
COMBUSTION OF n-BUTANE AND ISOBUTANE IN AN INTERNAL COMBUSTION ENGINE: A COMPARISON OF EXPERIMENTAL AND MODELING RESULTS
R. D. Wilk, W. J. Pitz, C. K. Westbrook, S. Addagarla, D. L. Miller, N. P. Cernansky, and R. M. Green (Sandia National Labs., Albuquerque, NM.) 13 Dec. 1989 18 p Presented at the 23rd International Symposium on Combustion, Orleans, France, 22-27 Jul. 1990
(Contracts W-7405-eng-48; DE-FG04-87AL-44658)
(DE90-005993; UCRL-102496; CONF-900704-3) Avail: NTIS HC A03/MF A01

The n-butane and isobutane are used in a test engine to examine the importance of molecular structure in determining knock tendency. The experimental results are interpreted using a detailed chemical kinetic model. Temporally resolved samples were withdrawn from the combustion chamber, providing measured histories of the concentrations of a wide variety of reactant, olefin, carbonyl, and other intermediate and product species. Calculations show that RO2 isomerization reactions are more important contributors to chain branching in n-butane oxidation than in isobutane oxidation. Chain branching in isobutane oxidation is dependent on H-atom abstraction reactions involving HO2 and CH3O2 radicals that occur at higher temperatures than RO2 isomerization reactions. Therefore, an isobutane mixture must be raised to a higher temperature than a n-butane mixture to achieve the same overall rate of reaction. DOE

N90-24401# Sandia National Labs., Albuquerque, NM.
TITANIUM-BORON MIXTURES AS VARIABLE HEAT SOURCES
David R. Begeal and Alan C. Munger (EG and G Mound Applied Technologies, Miamisburg, OH.) 1990 17 p Presented at the 15th International Pyrotechnics Seminar, Boulder, CO, 9-13 Jul. 1990
(Contract DE-AC04-76DP-00789)
(DE90-009729; SAND-90-0005C; CONF-900792-2) Avail: NTIS HC A03/MF A01

The reaction between titanium and boron to form titanium diboride is one of the hottest pyrotechnic reactions in common usage and offers the advantage of being a solid state gasless reaction. Based on the work of Hart, a heat source with a variable output was developed that utilizes this pyrotechnic. The device was designed to deliver the heat across a 0.26 inch inner diameter hemispherical bulkhead of a material and thickness that can be specified by the user. For evaluation purposes, the bulkhead was 0.036 inches thick stainless steel. The maximum temperature on the tip of the bulkhead was 950 C for the pure reactants and 680 C for blends diluted with 30 weight percent of alumina. Further, the temperature was uniform within (= or -)20 C across a 2 millimeter diameter on the tip of the bulkhead, and the temperature rise characteristics were repeatable. Ignition of the titanium/boron heat powder was accomplished by first igniting an adjacent charge of titanium subhydride/potassium perchlorate with a one ohm bridge wire. The header was constructed of inconel, a glass ceramic insulator, and Hastelloy pins. The ignition and subsequent burn of the titanium/boron was nearly instantaneous, thus the thermal output was dependent only on the heat transfer properties of the materials and geometry involved. Therefore, the user can tailor the blend dilution and the bulkhead characteristics to provide a large range of precise heat outputs. Typical uses of this heat source include timely ignition of other materials, or heating confined gas to perform useful mechanical work. Achievement of the precise heat output required special attention to the purity of the titanium and boron and to the blending process. These aspects, as well as those described above are described. DOE

N90-24402# Midwest Research Inst., Golden, CO.
DIAGNOSTICS OF GLOW DISCHARGES USED TO PRODUCE HYDROGENATED AMORPHOUS SILICON FILMS Annual Report, 1 Dec. 1988 - 30 Nov. 1989
A. Gallagher, D. A. Doughty, and J. Doyle (Colorado Univ., Boulder.) May 1990 40 p
(Contract DE-AC02-83CH-10093)
(DE90-000329; SERI/TP-211-3747) Avail: NTIS HC A03/MF A01

Several characteristics of the film-producing radicals were measured in discharges used to produce hydrogenated amorphous silicon and germane films. Specifically, their surface reaction probability ((beta)) and spatial distribution n(x) between the discharge electrodes were measured. This was combined with previous information and models to improve understanding of the causes of deposition and film quality. The results of the 10 years of research on this topic are summarized, and combined with relevant results from other laboratories. This includes production and deposition mechanisms for the primary depositing species, as well as causes of film quality variations. DOE

N90-24403# Pennsylvania State Univ., University Park. Dept. of Physics.
VIBRATIONAL AND OPTICAL PROPERTIES OF AMORPHOUS METALS Progress Report, Jun. 1984 - Jun. 1990
Jeffrey S. Lannin Dec. 1989 9 p
(Contract DE-FG02-84ER-45095)
(DE90-011427; DOE/ER-45095/4) Avail: NTIS HC A02/MF A01

Indicated in this report are accomplishments achieved under DOE support of studies of amorphous metals. In the last year this program has been diversified to encompass measurements of

ultrathin films and clusters (of Bi). The results in this latter area, as well as Raman accomplishments in amorphous metals work, form the basis for the proposed work on clusters. More emphasis will thus be given in this report to the experimental facilities for ultrahigh vacuum cluster preparation and physical property measurements, along with preliminary results. A number of these aspects are also discussed in the body of the proposal, including the section on experimental methods and facilities. Following the discussion of recent progress on cluster studies, a summary of the major achievements in the study of amorphous metals by Raman scattering, inelastic neutron scattering, neutron diffraction and spectroscopic ellipsometry are presented. DOE

N90-24354*# Battelle Pacific Northwest Labs., Richland, WA.
ANODE MATERIALS FOR ELECTROCHEMICAL WASTE DESTRUCTION
Peter M. Molton and Clayton Clarke (Florida Agricultural and Mechanical Univ., Tallahassee.) *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 19-28 (For primary document see N90-24350 18-23)
(Contract DE-AC06-76RL-01830)
Avail: NTIS HC A09/MF A02 CSCL 07D

N90-24588*# California Univ., San Diego. Chemical Engineering Group.
CO-OXIDATION CATALYSTS: LOW-TEMPERATURE CO OXIDATION OVER NOBLE-METAL REDUCIBLE OXIDE (NMRO) CATALYSTS
Richard K. Herz *In* NASA, Langley Research Center, Low Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 21-40 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

N90-24594*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ALTERNATIVE CATALYSTS FOR LOW-TEMPERATURE CO-OXIDATION
Steven D. Gardner, Gar B. Hoflund (Florida Univ., Gainesville.), David R. Schryer, Jacqueline Schryer, Billy T. Upchurch, and David R. Brown *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 123-137 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

N90-24597*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE EFFECT OF H2O AND PRETREATMENT ON THE ACTIVITY OF A Pt/SnO2 CATALYST
John D. VanNorman, Kenneth G. Brown, Jacqueline Schryer, David R. Schryer, Billy T. Upchurch, and Barry D. Sidney (Science and Technology Corp., Hampton, VA.) *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 181-191 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

N90-24598*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RARE-ISOTOPE AND KINETIC STUDIES OF Pt/SnO2 CATALYSTS
Billy T. Upchurch, George M. Wood, David R. Schryer, Robert V. Hess, Irvin M. Miller, and Erik J. Kielin (Old Dominion Univ., Norfolk, VA.) *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 193-199 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

N90-24599*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EFFECT OF PRETREATMENT ON A PLATINIZED TIN OXIDE CATALYST USED FOR LOW-TEMPERATURE CO-OXIDATION
Jean E. Drawdy, Gar B. Hoflund, Steven D. Gardner (Florida Univ., Gainesville.), Eva Yngvadottir, fu386635, and David R. Schryer *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 201-215 (For primary document see N90-24586 18-36)
(Grant NAG1-794)
Avail: NTIS HC A18/MF A03 CSCL 07D

N90-24601*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CHARACTERIZATION STUDY OF POLYCRYSTALLINE TIN OXIDE SURFACES BEFORE AND AFTER REDUCTION IN CO
Jean E. Drawdy, Gar B. Hoflund, Mark R. Davidson (Florida Univ., Gainesville.), and David R. Schryer *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 231-250 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

N90-24602*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ISS AND TPD STUDY OF THE ADSORPTION AND INTERACTION OF CO AND H2 ON POLYCRYSTALLINE Pt
Orlando Melendez, Gar B. Hoflund (Florida Univ., Gainesville.), and David R. Schryer *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 251-261 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

N90-24603*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemical Engineering.
SURFACE DEFECTS AND CHEMISTRY ON THE SnO2(110) SURFACE
David F. Cox *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 263-275 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

N90-24604*# National Inst. of Standards and Technology, Gaithersburg, MD. Chemical Process Metrology Div.
REVIEW OF MODEL SENSOR STUDIES ON Pd/SnO2(110) SURFACES
Teresa B. Fryberger and Steve Semancik *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 277-289 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

N90-24605*# Brunel Univ., Uxbridge (England). Dept. of Chemistry.
IN SITU ANALYSIS OF CO DURING CHEMISORPTION AND OXIDATION ON GRAPHITE: SUPPORTED Pt BY FTIR-MICROSPECTROMETRY
Valerie A. Self and Paul A. Sermon *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 291-295 Sponsored in part by Science Research Council (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

N90-24606*# Brunel Univ., Uxbridge (England). Dept. of Chemistry.
CALORIMETRY, ACTIVITY, AND MICRO-FTIR ANALYSIS OF CO CHEMISORPTION, TITRATION, AND OXIDATION ON SUPPORTED Pt
Paul A. Sermon, Valerie A. Self, Mariana S. W. Vong, and Alpha T. Wurie *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 297-307 Sponsored in part by Science Reseach Council and rch Council and Johnson Matneny Chemicals Ltd., London, England (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

N90-24607*# Brunel Univ., Uxbridge (England). Dept. of Chemistry.
ANALYSIS OF Pt/SnO(SUB x) DURING CATALYSIS OF CO OXIDATION
Paul A. Sermon, Valerie A. Self, and E. P. S. Barrett *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 309-312 Sponsored in part by Science Research Council (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

N90-24608*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CHARACTERIZATION OF THE SURFACES OF PLATINUM/TIN OXIDE BASED CATALYSTS BY FOURIER TRANSFORM INFRARED SPECTROSCOPY (FTIR)
Joseph T. Keiser and Billy T. Upchurch *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 313-320 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

N90-24609*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CHEMISORPTION STUDIES OF Pt/SnO2 CATALYSTS
Kenneth G. Brown, Susan K. Ohorodnik, John D. VanNorman, Jacqueline Schryer (Old Dominion Univ., Norfolk, VA.), Billy T. Upchurch, and David R. Schryer *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 321-335 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

N90-24615*# UOP Ltd., Enfield (England).
APPLICATIONS OF LOW TEMPERATURE CO-OXIDATION CATALYSTS TO BREATHABLE GASES
Ehsan Noordally and John R. Richmond *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 387-402 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

N90-24616*# Artech Associates, East Haven, CT.
POTENTIAL TECHNOLOGY TRANSFERS OF RESEARCH ON LOW-TEMPERATURE CARBON MONOXIDE-OXYGEN RECOMBINATION CATALYSTS
Edward J. Poziomek *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 403-409 Sponsored in part by American Association for the Advancement of Science, Washington, DC and EPA, Washington, DC (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

N90-25054*# Richmond Univ., VA. Dept. of Chemistry.
CHARACTERIZATION OF THE SURFACES OF PLATINUM/TIN OXIDE BASED CATALYSTS BY FOURIER TRANSFORM SPECTROSCOPY (FTIR) Abstract Only
Joseph T. Keiser *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 93-94 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 07D

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N90-24404 Lehigh Univ., Bethlehem, PA.
MECHANISTIC MODELING OF CORROSION FATIGUE CRACK GROWTH OF STEELS IN AQUEOUS SOLUTIONS Ph.D. Thesis
James Paul Thomas 1989 240 p
Avail: Univ. Microfilms Order No. DA9008094

The primary objective was to develop a model for the effects of the range of stress intensity factor (delta K), cyclic loading frequency (f), and temperature (T) on the enhancement of the crack growth rate (ECGR) for medium to high strength steels in aqueous environments. Also, an understanding was sought for the role played by delta K, f, and T on the chemical and mechanical processes leading to an ECGR. An experimental study was performed to determine the crack growth (CG) response of a HY-130 steel in de-aerated 3.5 percent NaCl solution, as a function of delta K, f, and T. Tests were performed at the delta K levels: 30, 21, and 14.5 MPa square root of m, with R = 0.25; four temperatures, from 273 to 345 K; and eight frequencies, from 0.05 to 10 Hz; and polarization at -800 mV (SCE). Reference rate tests were performed in dehumidified ultra high purity argon gas. The crack growth rate (CGR) exhibited an exponential-like dependence on 1/f, with saturation occurring as the frequency decreased. Increases in delta K increased the saturation CGR and shifted the data to lower frequencies. Increases in temperature shifted the CG response curve to higher frequencies, which correspond to an apparent activation energy of 30 kJ/mol. A modeling framework was developed to link the chemical and mechanical processes occurring at the crack-tip. A model for the CG response, as a function of f and T, was developed based on the kinetic response of the transient surface reactions. The CG response is related to the charge transferred during the transient reactions, which explains the frequency and temperature dependence in terms of reaction kinetics and time. A model for the CGR magnitude, as a function of K(sub max) and the saturation charge transfer level, was developed based on the distribution of hydrogen at the crack-tip. The model accounts for the effect of K on the CGR in terms of its effect on the hydrogen distribution and the local crack-tip environment. Dissert. Abstr.

N90-24405*# Virginia Univ., Charlottesville. Dept. of Materials Science.
CORROSION FATIGUE CRACK PROPAGATION IN METALS Final Report
Richard P. Gangloff Washington NASA Jun. 1990 202 p Presented at the 1st International Conference on Environment Induced Cracking of Metals, Kohler, WI, Sep. 1988 Submitted for publication
(Grant NAG1-745)
(NASA-CR-4301; NAS 1.26:4301) Avail: NTIS HC A10/MF A02 CSCL 11F

This review assesses fracture mechanics data and mechanistic models for corrosion fatigue crack propagation in structural alloys exposed to ambient temperature gases and electrolytes. Extensive stress intensity-crack growth rate data exist for ferrous, aluminum and nickel based alloys in a variety of environments. Interactive variables (viz., stress intensity range, mean stress, alloy composition and microstructure, loading frequency, temperature, gas pressure and electrode potential) strongly affect crack growth kinetics and complicate fatigue control. Mechanistic models to predict crack growth rates were formulated by coupling crack tip mechanics with occluded crack chemistry, and from both the hydrogen embrittlement and anodic dissolution/film rupture perspectives. Research is required to better define: (1) environmental effects near threshold and on crack closure; (2) damage tolerant life prediction codes and the validity of similitude; (3) the behavior of microcrack; (4) probes and improved models of crack tip damage; and (5) the cracking performance of advanced alloys and composites. Author

N90-24406# Oak Ridge National Lab., TN. Metals and Ceramics Div.
A STUDY OF THE PHASE DECOMPOSITION OF Fe-Ni-Al-Mo ALLOYS
M. K. Miller, M. G. Hetherington, J. R. Weertman, and H. A. Calderon (Northwestern Univ., Evanston, IL.) 1990 4 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990 Sponsored by Science Research Council
(Contract DE-AC05-84OR-21400)

(DE90-010143; CONF-900466-11) Avail: NTIS HC A01/MF A01

The aging of beta prime NiAl precipitates in ferritic Fe-Ni-Al alloys was studied by transmission electron microscopy (TEM) and atom-probe field-ion microscopy (APFIM). The addition of Mo alters the lattice parameter of the phases and segregation of Mo to the interface between the matrix and the particles may alter the interfacial energy. The compositions of the matrix, precipitates and interfaces were measured by TEM and APFIM. The results are compared. DOE

N90-24407# Argonne National Lab., IL. Materials Science Div.
GRAIN GROWTH AND PHASE FORMATION IN ION IRRADIATED/ANNEALED THIN NI-AI ALLOYS FILMS
Dale E. Alexander, Gary S. Was (Michigan Univ., Ann Arbor.), and Lynn E. Rehn Jan. 1990 7 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989
(Contract W-31-109-eng-38; NSF DMR-86-03174)
(DE90-010409; CONF-891119-129) Avail: NTIS HC A02/MF A01

Ion irradiation and annealing studies were performed on Ni, Ni-20 at. percent Al multilayers and Ni-20 at. percent Al co-evaporated thin films. Xe(+) ions were used to irradiate the films and homogenize the multilayers at room temperature. Irradiation of alloy films formed a metastable, supersaturated solid solution of gamma phase and an HCP phase. Ion induced grain growth occurred in all films. A factor of 2 greater growth was observed in Ni-Al multilayers compared with coevaporated films irradiated to the same dose. The enhancement is attributed to a heat of mixing effect. Post irradiation annealing of the mixed multilayers formed gamma prime, the morphology of which was dependent upon the presence of Cu in the films due to substrate mixing from the support grid. DOE

N90-24408# Oak Ridge National Lab., TN. Metals and Ceramics Div.
THE MEASUREMENT OF COMPOSITION DURING THE EARLY STAGES OF THE SPINODAL DECOMPOSITION OF Fe-Cr ALLOYS
M. G. Hetherington, J. M. Hyde (Oxford Univ., England), and M. K. Miller 1990 6 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990 Sponsored by Science Research Council
(Contract DE-AC05-84OR-21400)
(DE90-010471; CONF-900466-20) Avail: NTIS HC A02/MF A01

The properties of many advanced alloys are derived from extremely fine-scale microstructures. This poses interesting questions about the measurement of composition on this scale. The phase separation of model Fe-Cr alloys has been studied with the atom-probe. Statistical techniques have been used to estimate the composition and compare the results with the predictions of linear and non-linear theories of spinodal decomposition and the distributions obtained from Monte-Carlo calculations. DOE

N90-24409# Oak Ridge National Lab., TN. Metals and Ceramics Div.
SUBSURFACE HARDENING AND FLOW OF ALUMINUM DURING THE INCUBATION PERIOD OF SOLID PARTICLE EROSION
Mukund Rao (Notre Dame Univ., IN.), James R. Keiser, and Dane F. Wilson 1990 19 p Presented at the 4th Berkeley International Conference on Erosion-Corrosion-Wear of Materials at Evevated Temperatures, Berkeley, CA, 31 Jan. - 2 Feb. 1990
(Contract DE-AC05-84OR-21400)
(DE90-010141; CONF-900107-4) Avail: NTIS HC A03/MF A01

Samples of annealed 1100 Al were eroded by 600 to 700 micron spherical steel shot impacting at an angle of 30 degrees to the surface at 45 m/s. The extent of erosion was controlled by varying the dose of solid particle erodent so as to cover the incubation period where the erosion rate is not yet constant. A characteristic ripple structure was observed on the surface with increasing particle dose. The increase of deformation of the subsurface layers was studied using taper-sectioning techniques in conjunction with a mechanical properties microprobe. Distinct differences were observed in the hardness profiles beneath crests and valleys which form the ripple structure. These results are used to discuss material deformation and flow as erosion proceeds. DOE

N90-24410# Lawrence Livermore National Lab., CA. Dept. of Chemistry and Materials Science.
ELECTRONIC STRUCTURE AND PHASE STABILITY PROPERTIES OF Al-Li ALLOYS
Antonios Gonis, Patrice E. A. Turchi, Marcel Sluiter, Frank J. Pinski, and Duane D. Johnson (Sandia National Labs., Albuquerque, NM.) 18 Apr. 1990 13 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 15-20 Apr. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE90-010632; UCRL-JC-103609; CONF-900466-27) Avail: NTIS HC A03/MF A01

Recently, the phase diagram of Al-Li alloys was calculated with the use of the Connolly-Williams method. In an effort to test the validity and to supplement the results of that study, equilibrium lattice constants and effective cluster interactions have been obtained using the generalized perturbation method within the first-principles multiple-scattering formalism of the Korringa-Kohn-Rostoker coherent-potential approximation. The implication of these effective interactions to the phase stability of these alloys is discussed. DOE

N90-24411# Lawrence Livermore National Lab., CA.
A FIRST PRINCIPLES EXAMINATION OF PHASE STABILITY IN FCC-BASED ORDERED Ni-V ALLOYS
J. Mikalopas, Patrice E. A. Turchi, Marcel Sluiter, and P. A. Sterne 18 Apr. 1990 7 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 15-20 Apr. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE90-010635; UCRL-JC-103610; CONF-900466-26) Avail: NTIS HC A02/MF A01

The phase stability of fcc-based ordered Ni-V alloys is investigated using linear muffin-tin orbitals total energy (LMTO) calculations. The method of Connolly and Williams (CWM) is used to extract many body interactions from the ground state energies of selected ordered configurations. These interactions are used in conjunction with cluster variation method (CVM) to calculate the alloy phase diagram. The dependence of the interactions on the choice of configurations used to calculate them is examined. DOE

N90-24412# David Taylor Research Center, Bethesda, MD. Dept. of Ship Materials Engineering.
DAMPING ASSOCIATED WITH INCIPIENT MELTING IN ALUMINUM-INDIUM ALLOYS Research and Development Report, Oct. 1987 - Feb. 1989
C. R. Wong, O. Diehm, and D. C. VanAken (Michigan Univ., Ann Arbor.) Jan. 1990 19 p
(Contract N00014-87-K-0452)
(AD-A220241; DTRC/SME-89/95) Avail: NTIS HC A03/MF A01 CSCL 11/6

The strain amplitude dependent damping of binary aluminum-indium alloys containing nominally 0.6 to 17.3 weight percent indium was studied. A dynamic mechanical analyzer was used to measure the damping capacity of these materials. Pure aluminum (99.99 percent) exhibited strain dependent damping at strain values as low as 70 microstrain. The addition of 0.6 weight percent indium reduced the strain dependent damping by a factor of 2, but the strain dependent damping was equivalent to that of pure aluminum. Binary aluminum-indium alloys containing 4, 8, 12 and 16 weight percent indium exhibited a general increase in loss factor with increasing indium content; however, the strain dependent damping was no greater than that of the pure aluminum

sample. No significant increase in damping was observed when the binary alloys were tested at temperatures above the melting point of indium. Two damping peaks were observed near the eutectic melting point when tested at 10 Hz and differential scanning calorimetry verified both of these as due to the melting of the indium inclusions. It was concluded that the higher temperature damping peak was associated with smaller indium inclusions and that the damping peaks were related to the solute segregation associated with the binary eutectic reaction. GRA

N90-24413# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).
INFLUENCE OF SINTER TECHNICAL LIMITS FOR THE MANUFACTURING OF OSCILLATION STRAINED PIECES MADE OF SINTER STEEL
C. M. Sonsino 1989 224 p In GERMAN; ENGLISH summary (LBF-FB-184(1989); ETN-90-96464) Avail: NTIS HC A10/MF A02; Fraunhofer-Institut fuer Betriebsfestigkeit, Bartning Str. 47, 6100, Darmstadt, Fed. Republic of Germany, 95 DM

The influence of the sinter time, temperature and atmosphere on the behavior of several alloys of nickel, iron, copper, molybdenum and carbon was investigated. The tension-dilatation diagrams give the mechanical properties and allow characterization of the sinter density importance. With torsional stresses, high oscillation stiffness values are noticed, as with axial loading, which do not depend on the alloy composition. By a carbonitration the sinter steel can reach oscillation stiffness values which can be compared to those of laminated steels. ESA

N90-24414# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).
ABOUT THE EFFECT OF LOADING SEQUENCE ON THE FATIGUE LIFE OF NOTCHED SPECIMENS MADE FROM STEEL AND ALUMINUM ALLOYS
O. Buxbaum, H. Klaetschke, and H. Oppermann 1989 48 p In GERMAN; ENGLISH summary Sponsored by DFG (LBF-FB-186(1989); ETN-90-96465) Avail: NTIS HC A03/MF A01; Fraunhofer-Institut fuer Betriebsfestigkeit, Bartning Str. 47, 6100 Darmstadt, Fed. Republic of Germany, 35 DM

A statistical parameter which can be derived from the Markov matrix was defined in order to characterize the intermixture of random loading fluctuations. By means of this intermixture parameter load sequences for fatigue tests can be generated closer to reality and thus be more reliable. Also, effects resulting from loading sequences can be taken into account quantitatively in life calculations. The intermixture parameter was calculated for 17 test load sequences. The corresponding fatigue test results obtained for notched specimens (K sub t 1.4 up to 3.6) made from steels or aluminum alloys either under bending or axial loading, led to a general relation between intermixture and fatigue life being primarily influenced by the stress ratio. ESA

N90-24415# Army Materials Technology Lab., Watertown, MA. Materials Science Branch.
PRECIPITATION ON DISLOCATIONS IN Al-Li-Cc-Mg-Zr Final Report
D. M. Vanderwalker Mar. 1990 12 p
(DA Proj. 1L1-61102-AH-42)
(AD-A221124; MTL-TR-90-16) Avail: NTIS HC A03/MF A01 CSCL 11/6

Transmission electron microscopy was used to study precipitation processes on dislocation lines in Al(2.5)Li(1.3)Cu-(0.7)Mg(0.12)Zr wt precent aged at 190 C. Upon aging, a series of dislocation dissociation and precipitation reactions occur. The T1-Al2CuLi phase nucleates on dislocations in the (111) glide planes inducing the lattice dislocation to dissociate. On the remaining dislocation segment, S'Al2CuMg plates form causing the lattice dislocation to dissociate into a configuration with a Shockley partial on one side and a climbing partial on the other, such that S plates are on the (210) plane. T1 phases nucleate from the surface of S plates on conjugate (111) with an interfacial dislocation glide motion. GRA

N90-24416# Virginia Univ., Charlottesville. Dept. of Materials Science.
PROCESSING AND PROPERTIES OF ADVANCED ALUMINUM ALLOYS Final Report, 1 Jan. 1987 - 31 Dec. 1989
J. A. Wert and E. A. Starke Mar. 1990 150 p
(Grant AF-AFOSR-0082-87; AF Proj. 2306)
(AD-A221292; UVA/525672/MS90/101; AFOSR-90-0383TR)
Avail: NTIS HC A07/MF A01 CSCL 11/6

This research has been concerned with the use of processing to optimize the microstructure of advanced aluminum alloys for property improvement. The report was concerned with microstructure control and fracture. The focus was on the effect of shearable and non-shearable precipitates on slip behavior, void nucleation and fracture; the effect of composition on quench sensitivity and fracture; the effect of nonequilibrium eutectic melting during solution heat treatment on intergranular fracture; and the effect of slip behavior on fatigue crack propagation. Task 2 is covered in Part 2 of this report and was concerned with processing of advanced aluminum alloys for microstructure control for improvement of superplastic forming properties. The detailed studies of this task have allowed identification of the material and processing parameters that control development of the microstructural features required for superplasticity. GRA

N90-24417# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Physical Metallurgy.
STUDIES ON PHOSPHORUS SEGREGATION IN AUSTENITE Ph.D. Thesis
Martti Paju 1989 59 p Sponsored by BMFT; Teknillisen Korkeakoulun Tukisaeaetioe; and Ovako Steel Imatra
(ISBN-952-90-1488-0; ETN-90-96950) Avail: NTIS HC A04/MF A01

Research papers on various aspects of phosphorus segregation in austenite are presented. Experimental studies of phosphorus segregation in austenite in the binary Fe-P system as well as in different Fe-P-X-alloys are included. Grain boundary segregation of solute elements is given particular attention. The measurement techniques used are described. These include Auger electron spectroscopy and scanning electron microscopy. The general thermodynamic background of segregation and the thermodynamic models used to describe the segregation equilibrium and kinetics in binary as well as ternary systems are discussed. ESA

N90-24418# Oak Ridge National Lab., TN. Metal and Ceramics Div.
MORPHOLOGICAL AND STRUCTURAL CHARACTERIZATION OF THE SPINODAL DECOMPOSITION OF Fe-Cr ALLOYS
A. Cerezo, M. G. Hetherington, J. M. Hyde (Oxford Univ., England), and M. K. Miller 1990 6 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990 Sponsored in part by SERC, and The Royal Society and Central Electricity Generating Board
(Contract DE-AC05-84OR-21400)
(DE90-010496; CONF-900466-34) Avail: NTIS HC A02/MF A01

The position sensitive atom-probe (POSAP) is capable of extremely high resolution (sub-nanometer) microanalysis. Its 3-dimensional capabilities are unique and offer a new opportunity to study the topology and structure of materials. This paper is an initial overview of the new types of parameters and analysis that this technique makes possible. DOE

N90-24419# Los Alamos National Lab., NM.
ENCODING OF THE BURGESS METAL ELECTRICAL RESISTIVITY MODEL INTO SESAME FORMAT AND ITS ADAPTATION TO THE METAL NICKEL
Scott L. Woodside and Arthur E. Greene Mar. 1990 13 p
(Contract W-7405-eng-36)
(DE90-010816; LA-11762-MS) Avail: NTIS HC A03/MF A01

An electrical resistivity model of metals was encoded into a computer program that calculates the resistivities as functions of temperature and density and provides the results in the format of the Los Alamos SESAME equation-of-state library. This model is

rather heuristic. However, it is of interest because it concentrates on the low-temperature regimes and the solid to liquid to vapor transitions. These are areas that are not well handled by first principle theories. Burgess' publication provides input for six metals: aluminum, copper, gold, silver, stainless steel, and tungsten. The model was extended to include the metal nickel. The purposes of this extension were to assist in understanding the model in detail and to provide others with an approach for adapting the model to yet other metals. The results of the calculations were made available on public files SESCU9. DOE

N90-24420# Lawrence Livermore National Lab., CA.
AMBIENT-TEMPERATURE CREEP FAILURE OF SILVER-AIDED DIFFUSION BONDS BETWEEN STEEL
G. A. Henshall, M. E. Kassner, and R. S. Rosen 15 Jan. 1990 21 p Presented at the 2nd International Conference on Diffusion Bonding-Applications, Cranfield, England, 28-29 Mar. 1990
(Contract W-7405-eng-48)
(DE90-010687; UCRL-101690; CONF-9003155-1) Avail: NTIS HC A03/MF A01

It has long been known that thin (e.g., 1 micron to 1 mm) interlayer bonds between higher strength base materials may have high ultimate tensile or rupture strengths despite the relatively low strength of the filler metal. The high strength of the joint is due to the mechanical constraint provided by the stronger base metals which restricts transverse contraction of the interlayer. The constraint produces a triaxial state of stress and reduces the effective stress, thus reducing the tendency for the interlayer to plastically deform. Plasticity of the base metal reduces the constraint and decreases the strength of the bond. The purpose of this work was twofold. First, the validity of the base metal accelerated delayed failure theory for bonds utilizing plastic base metals was checked. Creep rupture tests were performed on diffusion bonded specimens using silver interlayers deposited by planar-magnetron sputtering (PMS), a physical vapor deposition process. The PMS process was preferred because of the superior quality and strength of the bond and because this modern low temperature joining process is increasingly utilized for joining ceramic and composite materials. The role of plastic base metals in the fracture process was further investigated by conducting tensile rupture tests of diffusion bonds made with stainless steel base metals of different yield strengths, and therefore different creep rates. The second purpose was to determine whether delayed failure occurs in interlayer bonds between elastic base metals, which do not creep over the range of applied stresses. This question is particularly relevant since many alloys, ceramics and composites fall within this category. Again, ambient and near-ambient temperature creep rupture tests were performed at a variety of stresses below the UTS of the bond. DOE

N90-24421# Oak Ridge National Lab., TN. Metals and Ceramics Div.
IRRADIATION EFFECTS ON IMPACT BEHAVIOR OF 12Cr-1MoVW AND 2 1/4Cr-1Mo STEELS
R. L. Klueh and D. J. Alexander 1990 26 p Presented at the 15th Symposium on Effects of Radiation on Materials, Nashville, TN, 17-21 Jun. 1990
(Contract DE-AC05-84OR-21400)
(DE90-011075; CONF-900623-7) Avail: NTIS HC A03/MF A01

Charpy impact tests were conducted on 12CR-1MoVW steel after irradiation in the Fast Flux Test Facility (FFTF) and the Oak Ridge Research Reactor (OOR). One half-size and one third-size Charpy specimens were irradiated in FFTF at 365 C. After irradiating half-size-specimens to approx 10 and 17 dpa, a shift in ductile-brittle-transition temperature (DBTT) of 160 C was observed for both fluences, indicating a saturation in the shift. A shift DBTT of 151 C was observed for the third-size specimens after irradiation to 10 dpa. Third-size specimens of 12Cr--1MoVW steel irradiated approx. 7 dpa in the ORR at 330 and 400 C developed shifts in DBTT of 200 and 120 C, respectively, somewhat above and below the shifts observed after irradiation at 365 C in FFTF. This correspondence of results in the mixed-spectrum ORR and the fast-spectrum FFTF is in marked contrast to large differences observed between specimens irradiated in the mixed-spectrum High Flux Isotope Reactor and the fast spectrum Experimental Breeder Reactor. The first data on the effect of fast reactor irradiation on the impact behavior 2(1/4) Cr--1Mo steel were obtained. Third-size specimens were irradiated in FFTF to approx. 10 dpa at 365 C. An increase in DBTT of 170 C was observed, similar of the shift observed for 12Cr--1MoVW steel following comparable irradiation. The reduction in the upper-shelf energy for the 2(1/4) Cr--1Mo steel was less than that observed for 12Cr--1MoVW steel. Because of the low DBTT of unirradiated 2(1/4) Cr--1Mo steel, the DBTT after irradiation remained below that for 12Cr--1MoVW steel. DOE

N90-24422# Argonne National Lab., IL. Materials Science Div.
EFFECTS OF INTERNAL HYDROGEN ON THE VACANCY LOOP FORMATION PROBABILITY IN Al
Tho X. Bui, E. Sirois, I. M. Robertson (Illinois Univ., Urbana.), and M. A. Kirk Apr. 1990 21 p Presented at the 15th Symposium on Effects of Radiation on Materials, Nashville, TN, 17-21 Jun. 1990
(Contracts W-31-109-eng-38; DE-AC02-76ER-01198)
(DE90-011114; CONF-900623-8) Avail: NTIS HC A03/MF A01

The effect of internal hydrogen on the formation of vacancy dislocation loops from heavy-ion generated displacement cascades in Al has been investigated. Samples of high purity aluminum and aluminum containing 900 and 1300 appM of hydrogen were irradiated at room temperature with 50 keV Kr+ ions. The ion dose rate was typically 2 x 10(exp 10)ions/sq cm/sec and the ion dose was between 10(exp 11) and 10(exp 13) ion/sq cm. Under these irradiation conditions, dislocation loops were observed in all compositions, although the formation probability was relatively low (less than 10 percent of the displacement cascades produced a vacancy loop). The loop formation probability was further reduced by the presence of hydrogen. No difference in the geometry or the size of the loops created in the hydrogen free and hydrogen charged samples was found. These results are difficult to interpret, and the explanation may lie in the distribution and form of the hydrogen. To account for the large hydrogen concentrations and from calculations of the energy associated with hydrogen entry into aluminum, it has been suggested that the hydrogen enters the aluminum lattice with an accompanying vacancy. This will create hydrogen-vacancy complexes in the material; 2-D complexes were detected in the hydrogen-charged, but unirradiated, samples by the small angle x ray scattering technique. The possibility of these complexes trapping the vacancies produced by the cascade process exists thus lowering the formation probability. However, such a mechanism must occur within the lifetime of the cascade. Alternatively, if a displacement cascade overlaps with the hydrogen vacancy complexes, the lower atomic density of the region will result in an increase in the cascade volume (decrease in the local vacancy concentration) which will also reduce the loop formation probability. DOE

N90-24423# Argonne National Lab., IL. Materials Science Div.
CASCADE COLLAPSE IN COPPER AND NICKEL
J. S. Vetrano, I. M. Robertson, R. S. Averback (Illinois Univ., Urbana.), and M. A. Kirk Apr. 1990 22 p Presented at the 15th Symposium on Effects of Radiation on Materials, Nashville, TN, 17-21 Jun. 1990
(Contracts W-31-109-eng-38; DE-AC02-76ER-01198)
(DE90-011115; CONF-900623-9) Avail: NTIS HC A03/MF A01

In-situ TEM studies of the deveiopment of the damage structure produced by heavy ion irradiations were performed in copper and nickel to investigate the possibility that melting occurs in local regions within displacement cascades. These experiments reveal that as the ion dose increases additional loops form from isolated displacement cascades, but more surprisingly some of the pre-existing loops are annihilated, change position, size and/or Burgers vector. It was also found that the probability for loop formation and the defect image size are greater in copper than in nickel even at temperatures well below stage 3. It is demonstrated that these observations provide supporting evidence, albeit indirect, that local melting occurs within the cascade core. These results

are compared to the molecular dynamic computer simulations of the damage created by low energy self-ions in copper and nickel. DOE

N90-24424# Lawrence Livermore National Lab., CA.
FIRST-PRINCIPLES INTERATOMIC POTENTIALS FOR TRANSITION METALS AND THEIR SURFACES
J. A. Moriarty and R. B. Phillips (Sandia National Labs., Albuquerque, NM.) Apr. 1990 8 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract W-7405-eng-48)
(DE90-011233; UCRL-102333; CONF-900466-39) Avail: NTIS HC A02/MF A01

For bulk transition metals, a first-principles generalized pseudopotential theory (GPT) of interatomic potentials was developed in which the cohesive-energy functional takes form of a volume term plus sums over widely transferable two-, three-, and four-ion potentials. The GPT was further extended to surfaces by making an internal transformation of this functional to an embedded-atom-like format in which the embedding function is identified as the bulk volume term and the atomic volume is replaced by an average electron density. Applications of the bulk and surface GPT to the calculation of structural, vacancy-formation, and surface energies in Cu and Mo, and to the investigation of surface relaxation and reconstruction in Mo are discussed. DOE

N90-24425# Oak Ridge National Lab., TN.
DEVELOPMENT AND EVALUATION OF ADVANCED AUSTENITIC ALLOYS
R. W. Swindeman, P. J. Maziasz, J. F. King, and E. Bolling 1990 11 p Presented at the 4th Conference on Fossil Energy Materials, Oak Ridge, 15-17 May 1990
(Contract DE-AC05-84OR-21400)
(DE90-011315; CONF-900546-4) Avail: NTIS HC A03/MF A01

Research was performed on advanced austenitic alloys for tubing in heat recovery systems. Evaluations addressed the need to optimize strength, fabricability, and surface protection for specific environments and temperatures. Alloys studied included advanced lean austenitic stainless steels and higher chromium alloys to 760 C, nickel-chromium-iron aluminides at temperature to 760 C, and Ni-Cr alloys with capability for service to 1000 C. Coordinated research was performed at a number of universities and industrial research facilities. Evaluation of the lean stainless steels focused on MC-forming alloys and a family of modified 316 stainless steels. Work nearing completion revealed that many of the alloy design criteria for the lean stainless steels could be met. With the judicious selection of thermal-mechanical processing, data indicated that high strength and ductility could be achieved in both base metal and weldments. Fabrication requirements needed to produce optimum performance called for high solution treating temperatures and small levels of cold or warm work. Evaluations of high chromium stainless steels and modifications of alloy 800H were encouraging, and good properties were observed for temperatures to 760 C. Work on the alloys and claddings for service to 1000 C was begun on two commercial alloys of nearest in PBFC hot gas cleanup systems. DOE

N90-24426# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Sciences Div.
FATIGUE CRACK PROPAGATION IN AUSTENITIC STAINLESS STEELS AT CRYOGENIC TEMPERATURES Ph.D. Thesis
Zequn Mei (California Univ., Davis.) Jan. 1990 101 p
(Contract DE-AC03-76SF-00099)
(DE90-011597; LBL-28489) Avail: NTIS HC A06/MF A01

This dissertation contains a study, in two parts, that relates to fatigue crack propagation in austenitic stainless steels at cryogenic temperatures. The first part of the research concentrates on the influence of the mechanically induced martensitic transformation on the fatigue crack growth rate in metastable austenitic stainless steels. The steels 304L and 304N were used to test the influence of composition, the testing temperatures 298 and 77 K were used to study the influence of test temperature, and various load ratios were used to determine the influence of the mean stress. The second part of the research concerns the effect of low temperature on fatigue crack propagation in 310 austenitic stainless steel. Crack growth rates were measured at 298, 77, and 4 K. As temperature decreased the fatigue crack growth rate decreased while the threshold stress intensity increased. DOE

N90-24427# Los Alamos National Lab., NM. Materials Science and Technology Div.
THE EFFECTS OF COOLING RATE XD (TRADEMARK) TiAl WELD MICROSTRUCTURE
Erica Robertson (Air Force Office of Scientific Research, Bolling AFB, Washington, DC.), Mary Ann Hill, and Ricardo B. Schwarz 1990 8 p Presented at the Spring Meeting of the Intermetallic Materials Research Society, 16-20 Apr. 1990, San Francisco, CA Sponsored in part by AFOSR, Bolling AFB, Washington, DC
(Contract W-7405-eng-36)
(DE90-011975; LA-UR-90-1616; CONF-900466-46) Avail: NTIS HC A02/MF A01

Fusion zone microstructures of an electron beam (EB) welded XD (trademark) Ti-48 at percent Al + 6.5 vol percent TiB2 alloy revealed the presence of a plate-like microstructural constituent which was absent in the base metal. The volume fraction of this phase increased with increasing cooling rate and correlated with increased weld cracking frequency. To determine whether this phase was a product of solidification from the melt or a product of a solid-state transformation, weld microstructures were compared to those cycled in a Gleebel 1500/20 Thermal-Mechanical Test System which was programmed to simulate the solid-state portion of the weld cooling rates (as predicted by a Rosenthal analysis). Both weld and simulation microstructures were characterized using x ray diffraction, optical and scanning electron microscopy. The plate-like phase found in the weld microstructures was identified as TiB2 occurring upon rapid solidification of the melted weld metal. DOE

N90-24355*# University of Western Michigan, Kalamazoo. Dept. of Mechanical Engineering.
A SIMPLE DEMONSTRATION OF CORROSION CELLS
Philip J. Guichelaar and Molly W. Williams *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 29-36 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11F

N90-24356*# Purdue Univ., West Lafayette, IN.
THERMAL CONDUCTIVITY OF METALS
Sayyed M. Kazem *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 37-43 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11F

N90-24466# Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer Werkstoffe.
SHAPE MEMORY ALLOYS FOR ROBOT GRIPPERS AND MECHANICAL HANDS
K. Escher and E. Hornbogen *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 27-32 Sponsored by DFVLR (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N90-24428 Missouri Univ., Rolla.
ABRASION RESISTANT COATINGS ON PLASTICS Ph.D. Thesis
Pornchai Laoharojanaphand 1989 181 p
Avail: Univ. Microfilms Order No. DA9008371

The increasing utilization of polymeric materials to replace metals in a wide variety of structural applications such as in buildings, automobiles and aircraft, has drawn attention to the importance of environmental induced surface failure which may limit the usefulness of these materials. In response to technological demands for developing surface protective coatings, the field of sol-gel processing has, during the last four decades, moved from an empirical body of accumulated experimental results to an increasingly attractive science, employing one of the most advanced techniques for making ceramic materials via chemistry. The process developed for the introduction of organic network modifiers into an inorganic backbone, synthesized at relatively low temperatures, seems to be a suitable synthesis method which develops a composite of organic and inorganic substances for use as a protective layer on plastic surfaces. Polymethyl methacrylate (PMMA), a rigid transparent engineering material with a measured hardness of 17.8 on the Vicker scale, was selected as a model substrate. Glow discharge polymerization of such reactive functional silanes as 3-methacryl oxypropyl trimethoxy-silane (MSL), 3-glycidoxypropyl trimethoxy-silane (ESL), and vinyl trimethoxy-silane on the PMMA was employed to develop the polymer surface favorable for subsequent modified silicate coatings. The coatings were polyorgano metalloxanos siloxanes modified with methacrylate networks prepared by a sol-gel process. The PMMA coated with the unique coatings gave an increased surface hardness of 39.0 on the Vicker scale. Dissert. Abstr.

N90-24429# Argonne National Lab., IL. Materials Science Div.
SURFACE ENRICHMENT AND EVAPORATION IN A POLYMER MIXTURE OF LONG AND SHORT CHAINS
Russell J. Composto, Richard S. Stein (Massachusetts Univ., Amherst.), Gian P. Felcher, Abdelkader Mansour, and Alamgir Karim Dec. 1989 6 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989
(Contract W-31-109-eng-38)
(DE90-010073; CONF-891119-124) Avail: NTIS HC A02/MF A01

Neutron reflectivity has been used to determine the concentration profile at the vacuum-polymer interface for a two polymer blend. To quantify surface enrichment and evaporation due to differences in chain length, the reflectivity of a mixture of short deuterated and long protonated polystyrene chains (DPS and PS) were measured with a weight fraction of 0.5. When a mixture of DPS and PS chains of molecular weight 720 and 910 k respectively were annealed, a small but measurable increase in asymptotic reflectivity occurred, coupled with a decrease of film thickness and scattering length density. This is indicative of surface enrichment and evaporation of the light chains (DPS). Ellipsometry studies confirmed that the short chains evaporated and its rate was established as a function of the temperature. Upon increasing the DPS molecular weight to 9600, the enrichment becomes considerably greater whilst the evaporation becomes negligible. DOE

N90-24430# Sandia National Labs., Albuquerque, NM.
EQUILIBRIUM SWELLING OF ELASTOMERIC MATERIALS IN SOLVENT ENVIRONMENTS
Peter F. Green Mar. 1990 25 p
(Contract DE-AC04-76DP-00789)
(DE90-010164; SAND-90-0421) Avail: NTIS HC A03/MF A01

The equilibrium swelling of silicones, fluorosilicones, VITON and ethylene-propylene-diene (EPDM) elastomers in an environment of the jet fuel JP4 was investigated. The volume of silicone and DPDM elastomers increased by approximately 100 percent when they were placed in a saturated environment of JP4. Conversely, the volume of the fluorosilicone elastomer increased by approximately 15 percent and that of VITON less than 1 percent. In acetone, a commonly used solvent, the equilibrium swelling of VITON and the fluorosilicone elastomer was excessive, on the order of 100 percent, wheras the silicone and EPDM elastomers exhibited small changes in dimensions. Reasons for these observations are discussed in detail. We also present a simple scheme by which one may, qualitatively, determine the dimensional stability of these elastomers in different solvents if the cohesive energy density of the solvent, which is readily available in a number of handbooks, is known. We also evaluated the vulnerability of some commonly used engineering thermoplastics to JP4. The results are tabulated. DOE

N90-24431# Connecticut Univ., Storrs. Dept. of Chemical Engineering.
COMPRESSION MOLDED POLYURETHANE BLOCK COPOLYMERS. 1: THERMAL AND THERMOMECHANICAL PROPERTIES
J. T. Koberstein, A. F. Galambos, and L. M. Leung 27 Mar. 1990 39 p Submitted for publication
(Contract N00014-86-K-0497; NSF DMR-81-054612; NSF DMR-82-06187)
(AD-A220068; TR-7-ONR) Avail: NTIS HC A03/MF A01 CSCL 11/9

The thermal and thermomechanical properties of a series of compression molded MDI/BDO/PPO-PEO segmented polyurethane block copolymers are reported as a function of hard segment content. Correlations between these properties show that the hard microdomain morphology is continuous for hard segment contents exceeding ca. 40 percent. At high program temperature rates, DSC thermograms exhibit a single high temperature endotherm corresponding to the melting of an extended form of MDI/BDO crystal. Multiple endotherms are observed at low DSC scan rates. For high hard segment content specimens, catastrophic softening is coincident with the onset of the first high temperature endotherm. The primary softening point for materials with discrete hard microdomains occurs at the soft microphase Tg. The soft microphase Tg is a minimum for a hard segment content of 50 percent. The apparent hard microdomain Tg decreases monotonically with increasing hard content and is consistent with heat capacity data for the soft microphase Tg which indicates increased incorporation of soft segment material into the hard microdomain for higher hard segment content materials. GRA

N90-24432# Technische Univ., Eindhoven (Netherlands).
DEFORMATION-INDUCED STRUCTURAL DEVELOPMENTS OF ULTRA-HIGH MOLECULAR WEIGHT POLYETHYLENE Ph.D. Thesis
Nicolaas Aldegonda J vanAerle 1989 145 p
(ETN-90-96899) Avail: NTIS HC A07/MF A01

The deformation of ultrahigh molecular weight polyethylene (UHMW-PE) was investigated under various conditions in order to gain a better understanding of the deformation processes and the resulting structures and properties. X ray diffraction was used as a characterization technique. With respect to isothermal drawing of UHMW-PE, three distinct temperature regions are shown to exist, corresponding to three different types of drawing behavior. ESA

N90-24433# Missouri Univ., Rolla. Dept. of Chemistry.
DENSITY PROFILE OF TERMINALLY ADSORBED POLYMERS Interim Report, Jan. 1989 - Jan. 1990
Frank D. Blum, Brijnaresh R. Sinha, and Fredrick C. Schwab 9 Apr. 1990 29 p
(Contract N00014-88-K-0109; NSF DMR-86-16789)
(AD-A220897; UMR-FDB-14) Avail: NTIS HC A03/MF A01 CSCL 07/6

Specifically labelled terpolymers of 2-vinylpyridine, styrene and deuterostyrene were prepared by anionic polymerization. The

deuterostyrene was deuterated in the methine position and positioned either in the middle or at the end of the triblock terpolymer. The moderately low molecular weight polymers (ca. 20,000 g.mol, polydispersity ca. 1.4) were then adsorbed onto high surface area silica. The environment of the styrene segments in the terpolymer attached to the silica surface and swollen with toluene was probed with deuterium NMR. Comparison of deuterium NMR spin lattice relaxation time, T1 for the adsorbed polymer to that of the polymer in solution suggests that the local concentration of styrene segments near the middle of the polymer, i.e., next to the vinylpyridine segments, is about 0.11 g/ml. GRA

N90-24434# Aerospace Corp., El Segundo, CA. Chemistry and Physics Lab.
EFFECTS OF MICROSTRUCTURE AND ADHESION ON PERFORMANCE OF SPUTTER-DEPOSITED MoS2 SOLID LUBRICANT COATINGS
Paul D. Fleischauer, Michael R. Hilton, and Reinhold Bauer 15 Jan. 1990 28 p
(Contract F04701-88-C-0089)
(AD-A220900; TOR-0090(5064)-2) Avail: NTIS HC A03/MF A01 CSCL 11/8

Selection of a lubricant for a given application (use) is determined by a number of factors. Analogous to fluid lubricants, where proper base stock, additive package, and formulation are selected for the application, choice of dry lubricants requires consideration of the appropriate deposition procedure, film composition, film structure, and substrate surface preparation procedure. The relationship between film physical and mechanical properties of molybdenum disulfide produced by RF, dc, and RF magnetron sputtering is reviewed. It is proposed that when the requirements of contact geometry, pressures (stresses), and operating life are considered, optimization of three essential properties of the coatings will provide the ultimate in performance: good coating-substrate adhesion, dense, small grain size (low porosity), and high chemical (phase) purity. GRA

N90-24435# Army Belvoir Research and Development Center, Fort Belvoir, VA. Materials, Fuels and Lubricants Lab.
FAILURE MECHANISM OF URETHANE ELASTOMER COATED FABRIC COLLAPSIBLE FUEL TANKS Final Report, Sep. - Dec. 1989
Henry O. Feuer, Jr. and Paul Touchet Mar. 1990 46 p
(AD-A221033; BRDEC-2488) Avail: NTIS HC A03/MF A01 CSCL 21/4

The failure mechanism of urethane elastomer coated fabric collapsible fuel storage tanks is investigated. Past work has dealt with fuel degradation causing the tanks to fail but that work has met with failure. The mechanism that causes these tanks to fail is an extraction process whereby the protective ingredients in the polymer coating are removed by the fuel causing the elastomer to degrade by hydrolysis. GRA

N90-24436# Texas Univ., Arlington. Dept. of Chemistry.
ELECTRONIC AND IONIC TRANSPORT IN PROCESSABLE CONDUCTING POLYMERS Quarterly Technical Report No. 19, 1 Jan. 1990 - 31 Mar. 1990
Martin Pomerantz, John R. Reynolds, Krishnan Rajeshwar, and Dennis S. Marynick 10 Apr. 1990 5 p
(Contract N00014-90-J-1320)
(AD-A221045) Avail: NTIS HC A01/MF A01 CSCL 07/3

A series of 2,5-distributed 1,4-bis(2-heterocycle) benzenes were synthesized and their respective polymers have been prepared chemically and electrochemically. Good electrical conductivity has been observed for the 2,5-dimethoxy derivative where the heterocycle is thiophene when the polymer is NOPF6 doped while the 2,5-dimethyl derivative shows much lower conductivity. Correlations of the electronic properties were made the theoretically calculated polymer band structures and minimum energy conformations. Multiangle laser light scattering molecular weight GPC studies of a number of different samples of poly-(3-octylthiophene) has shown a variation from sample to sample, all being fairly high. Fibers melt spun from blends of poly-(3-decylthiophene) and low density polyethylene (LDPE) were shown by electron microscopy to be phase separated and to actually be composites of the poly(3-decylthiophene) in the LDPE matrix. It was shown that films of self-doped poly-(pyrrole propanesulfonate) tenaciously bind useful photophysical molecules. It was also demonstrated how in-situ surface photochemistry at chemically modified electrodes offers a powerful route to catalyst generation at the surface. GRA

N90-24437# Missouri Univ., Rolla. Dept. of Chemistry.
DYNAMICS OF BULK AND SURFACE-ADSORBED POLYACRYLATES Interim Report, Mar. 1989 - Mar. 1990
Robert B. Funchess and Frank D. Blum 13 Apr. 1990 4 p
Submitted for publication Sponsored in part by NSF
(Contract N00014-88-K-0109)
(AD-A221046; UMR-FDB-15) Avail: NTIS HC A01/MF A01 CSCL 11/9

The dynamics of poly(isopropyl acrylate) and poly(ethyl acrylate) were studied by solid-state deuterium NMR. The polymers were specifically labelled in the methine polition and consequently the spectra are influenced directly by the backbone motion of the polymers. The deuterium NMR lineshapes of the two polymers in bulk were compared. For poly(ethyl acrylate) it was found that near and below Tg, a one component rigid spectrum is obtained. About 20 C above Tg, a two component spectrum is found with the intensity of the more mobile component increasing with temperature. By Tg + 50 the more mobile component dominates the spectrum. Comparison of the surface-bound and bulk poly(isopropyl acrylate) suggests that the surface bound materials are more constrained. GRA

N90-24438# Army Construction Engineering Research Lab., Champaign, IL.
EVALUATION OF ABRASION-RESISTANT METALLIZED COATINGS FOR CIVIL WORKS APPLICATIONS Final Report
Timothy D. Race, Vincent F. Hock, and Alfred Beitelmen Feb. 1990 40 p Sponsored by Corps of Engineers, Washington, DC
(AD-A221078; CERL-TR-M-90/06) Avail: NTIS HC A03/MF A01 CSCL 11/3

Vinyl coatings have been commonly used to protect U.S. Army Corps of Engineers hydraulic structures since the early 1950s. Under normal service conditions, vinyl coatings can protect the substrate for 30 years or longer. But vinyls exposed to very high abrasion fail completely in 12 to 24 months. The U.S. Army Construction Engineering Research Laboratory (USACERL) tested metallized coatings--much harder than conventional organic paints--in a highly abrasive environment to evaluate durability and corrosion resistance. Aluminum-bronze alloy, stainless steel, zinc, and zinc-aluminum alloy were applied by thermal spray to tainter gate No. 5 at Belleville Locks and Dam on the Ohio River. Results indicated excellent performance for the zinc and zinc-aluminum alloy coatings. However, aluminum-bronze and stainless steel coatings showed early signs of failure because of galvanic corrosion. GRA

N90-24439# Minnesota Univ., Minneapolis. Corrosion Research Center.
QUARTZ CRYSTAL MICROBALANCE ANALYSIS: PARTIAL CATION RELEASE DURING OXIDATION OF CONDUCTING POLYMERS Technical Report, 1 Jan. 1989 - 1 Mar. 1990
Katsuhiko Naoi and William H. Smyrl 15 Mar. 1990 3 p
Submitted for publication
(Contract N00014-88-K-0360)
(AD-A221091; TR-27-ONR) Avail: NTIS HC A01/MF A01 CSCL 07/6

In the process of charging (or oxidizing) conducting polymers, e.g., polypyrrole, polythiophene, polyaniline, it has been common to assume that exclusively anions can compensate the excess charge of the radical cation sites of polypyrrole in the oxidized state. Very recently, however, cation insertion has also been indicated by some workers. In this short note, the authors report strong evidence of cation/release in polypyrrole film and the

dependence of the proportion of anion and cation charge compensation of film thickness during the oxidation process.
GRA

N90-24440# Massachusetts Univ., Amherst. Dept. of Polymer Science and Engineering.
DURIP ADVANCED POLYMER SOLID STATE NMR INSTRUMENTATION Final Report, 1 Dec. 1988 - 30 Nov. 1989
David M. Rice Mar. 1990 10 p
(Grant AF-AFOSR-0184-89; AF Proj. 3842)
(AD-A221401; AFOSR-90-0436TR) Avail: NTIS HC A02/MF A01 CSCL 07/6

Instrumentation was provided for the advanced Nuclear Magnetic Resonance study of polymers in the solid state. The structure and morphology of Poly(p-phenylene vinylene) (PPV) and the Molecular Interactions in High Temperature Polymer Blends were studied. The instrumentation provided experimental capability in two new areas which are being used generally in further work. Methods were implemented for the NMR study of the structure and orientation of high strength films and fibers. These methods are now being used for the study of PBZT fibers. Two-dimensional NMR methods were developed which provides for quantitative measurement of conformation and domain structure of blends.
GRA

N90-24441# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
THE INTERFACE CHEMISTRY OF PHENOLIC AND EPOXY ADHESIVES WITH A MODEL ALUMINIUM SURFACE [DIE WECHSELWIRKUNG VON PHENOL- UND EPOXYDHARZKLEBSTOFFEN MIT EINER MODELL-ALUMINIUMOBERFLACHE]
F. Nitschke 1989 36 p In GERMAN Presented at European Conference of Applied Surface and Interface Analysis, Antibes, France, 23-27 Oct. 1989
(MBB-Z-0288-89-PUB; ETN-90-96972) Avail: NTIS HC A03/MF A01

Tests carried out on the bond interface between phenolic and epoxy adhesives and an aluminum surface are described. The properties of different adhesives available on the market are listed in tabular form. The chemical composition and the type of bonding within these adhesives is presented. The binding energy of the adhesives to a model aluminum surface is shown in graphic representations. Graphs for etched aluminum surfaces, resole absorbed on aluminum surface peeled from cured resole are presented. The percentage of carbon on the surfaces is measured.
ESA

N90-24442# Brown Univ., Providence, RI. Div. of Engineering.
CYCLIC DAMAGE ZONES AHEAD OF TENSILE FATIGUE CRACKS IN CERAMIC MATERIALS
S. Suresh and J. R. Brockenbrough (Aluminum Co. of America, Alcoa Center, PA.) Nov. 1989 7 p Presented at the Fatigue 1990 International Conference, Honolulu, HI, 15-20 Jul. 1990 Submitted for publication
(Contract DE-FG02-84ER-45167)
(DE90-008372; CONF-900764-1) Avail: NTIS HC A02/MF A01

The development of a reversed flow or cyclic plastic zone is known to play an important role in influencing the growth of fatigue cracks in ductile metals subjected to constant and variable amplitude cyclic loads. A detailed finite element analysis is presented of the evolution of cyclic damage zones ahead of stationary cracks in brittle materials subjected to zero-tension fatigue loading. The damage mechanism considered here involves isotropic microcracking along grain boundaries and/or interfaces. It is shown that cyclic damage zones are induced ahead of tensile fatigue cracks in microcracking brittle solids when there is irreversible deformation at the crack-tip. The size of the cyclic damage zone and the variation of residual stress fields within the zone were computed as a function of the extent of irreversibility of crack-tip damage.
DOE

N90-24443# Brown Univ., Providence, RI. Div. of Engineering.
FATIGUE CRACK GROWTH IN CERAMIC MATERIALS AT AMBIENT AND ELEVATED TEMPERATURES
S. Suresh Nov. 1989 10 p Presented at the Fatigue 1990 International Conference, Honolulu, HI, 15-20 Jul. 1990; sponsored by Japan Society of Materials Science Submitted for publication
(Contract DE-FG02-84ER-45167)
(DE90-008418; DOE/ER-45167/2; CONF-900764-2) Avail: NTIS HC A02/MF A01

The mechanics and mechanisms of stable fatigue crack growth in a wide variety of ceramics and ceramic composites are examined in detail. Experimental results on crack growth, numerical analyses and microscopic observations of crack-tip damage zones are presented to illustrate fatigue processes with: (1) a mode of failure that is distinctly different from that seen under static loads; (2) kinematic irreversibility of microscopic deformation which leads to cyclic damage zones, analogous to cyclic plastic zones in metal fatigue; and (3) crack velocities which are distinctly different from those found under static load failure due to a mechanical-environmental synergistic effect or as a result of purely mechanical contact phenomena such as crack closure, crack bridging by grains or reinforcements, or wedging of crack faces by debris particles.
DOE

N90-24444# Oak Ridge National Lab., TN.
THE INFLUENCE OF ION IMPLANTATION ON THE NEAR-SURFACE MECHANICAL PROPERTIES OF CERAMICS
C. J. McHargue, M. E. OHern, and D. L. Joslin (Tennessee Univ., Knoxville.) 1990 13 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract DE-AC05-84OR-21400)
(DE90-010139; CONF-900466-14) Avail: NTIS HC A03/MF A01

Ion implantation of ceramics such as Al2O3 and SiC may produce a highly damaged but crystalline surface layer or an amorphous surface. The specific structure depends upon the implantation parameters. Studies using microindentation techniques show that a crystalline implanted surface has a higher hardness (by 10 to 50 percent) than the corresponding unimplanted crystal but the elastic modulus is essentially unchanged. The hardness and elastic modulus of amorphous implanted surfaces are less than those of the crystalline material. Estimates of the residual stress were obtained from microindentation tests.
DOE

N90-24445# Sandia National Labs., Albuquerque, NM.
JOINING ENGINEERING CERAMICS
Ronald E. Loehman 1990 17 p Presented at the International Institute of Welding Conference, Montreal, Quebec, 23-24 Jul. 1990
(Contract DE-AC04-76DP-00789)
(DE90-010819; SAND-90-0966C; CONF-900774-2) Avail: NTIS HC A03/MF A01

Joining ceramics to metals requires solutions to both scientific and practical engineering problems. Scientific issues include understanding the fundamental nature of adhesion at metal-ceramic interfaces, predicting interfacial reactions, and understanding the relation between chemical bonding and mechanical stresses at the interface on the atomic level. Engineering a specific ceramic-metal joint requires finding the optimum among what may be inherently incompatible properties. The following review briefly outlines some of the different methods for joining ceramics. Following that, some fundamental aspects of ceramic joining are presented. The paper concludes with examples of ceramic bonding in several engineering ceramic systems.
DOE

N90-24446# Sandia National Labs., Albuquerque, NM.
PROPERTIES OF FILMS PREPARED FROM LOW SURFACE AREA/DENSITY ALUMINA-SILICA
S. L. Hietala, D. M. Smith, V. M. Hietala, G. C. Frye, A. J. Hurd (New Mexico Univ., Albuquerque.), and C. J. Brinker 1990 6 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990

(Contract DE-AC04-76DP-00789)
(DE90-011048; SAND-90-1111C; CONF-900466-36) Avail: NTIS HC A02/MF A01

A sol-gel method was used to prepare bulk, closed pore, amorphous alumina-silica. Films prepared from this 47 wt percent Al2O3-SiO2 composition were examined by SAW, elipsometry and electrical measurements. The films were found to have a surface area of 1.1 sq cm/sq cm, a refractive index of 1.44 at 633 nm, and a relative permittivity of 6.2 at 200 KHz. These properties indicate potential applications as hermetic seals, barrier coatings, dielectric layers for capacitors and passivation coatings for electronic circuits. DOE

N90-24447# Argonne National Lab., IL. Materials Science Div.
CERAMIC EPITAXIAL FILMS AND MULTILAYERS PREPARED BY MOCVD
H. L. M. Chang, H. You, J. C. Parker, J. Guo, Y. Gao, and D. J. Lam Apr. 1990 11 p Presented at the 7th World Ceramics Congress: Ceramics Today: Tomorrow's Ceramics, Montecatini Terme, Italy, 24-30 Jun. 1990
(Contract W-31-109-eng-38)
(DE90-011090; CONF-900634-1) Avail: NTIS HC A03/MF A01

Titanium and vanadium oxide systems were selected to study the MOCVD process for the growth of epitaxial thin films in single- and multilayer configurations. Epitaxial TiO2 and VO2 films were obtained on sapphire (1120), (0001), and (1102) but not on Si (111). Six distinct substrate-film epitaxy relationships were determined by carefully performed x ray diffraction studies using a four-circle x ray diffractometer. It is concluded that substrate materials and surface orientations are the most important factors for epitaxial film growth while growth temperature seems to play a secondary role. Detailed matching of local atomic arrangements between the film and substrate at the interface is discussed. DOE

N90-24448# Oak Ridge National Lab., TN.
CERAMIC TECHNOLOGY FOR ADVANCED HEAT ENGINES PROJECT DATA BASE Summary Report, Mar. 1989
B. L. P. Keyes Apr. 1990 119 p
(Contract DE-AC05-84OR-21400)
(DE90-011491; ORNL/M-1098) Avail: NTIS HC A05/MF A01

A large volume and wide variety of data on the behavior of advanced ceramic materials are currently being generated within the Ceramic Technology for Advanced Heat Engines (CTAHE) project. This is the third in a series of semiannual data summary reports and features all information now stored in the data base on silicon carbides and silicon nitrides, including whisker-reinforced silicon nitrides. A glossary defining many of the terms used in the data base and describing some of the standard properties tests used for ceramics has also been included. DOE

N90-24449# Pennsylvania State Univ., University Park. Dept. of Materials Science and Engineering.
FRACTURE BEHAVIOR OF SURFACE MODIFIED CERAMICS Progress Report
D. J. Green 1990 7 p
(Contract DE-FG02-86ER-45252)
(DE90-011552; DOE/ER-45252/T4) Avail: NTIS HC A02/MF A01

Progress made under this grant is briefly discussed. The grant has been in progress for 41 months at a total cost of $266,000. The report is divided into four sections: the indentation of ion-exchanged glass, influence of surface residual stresses on strength variability, indentation behavior of surface-modified yttria tetragonal zirconia, and residual surface stress characterization. DOE

N90-24450# California Univ., Berkeley. Lawrence Berkeley Lab.
POWER DENSITY EFFECTS IN THE PHYSICAL AND CHEMICAL PROPERTIES OF SPUTTERED DIAMOND-LIKE CARBON THIN FILMS
N.-H. Cho, K. M. Krishnan, D. K. Veirs, M. D. Rubin, C. B. Hopper, B. Bhushan, and D. B. Bogy (California Univ., Berkeley.) Nov. 1989 13 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989
(Contract DE-AC03-76SF-00098; NSF MSE-88-00149)
(DE90-011587; LBL-28348; CONF-891119-133) Avail: NTIS HC A03/MF A01

Thin films of diamond-like amorphous carbon were prepared by dc magnetron sputtering. A systematic variation in the physical properties of the films (mass density and electrical resistivity) was found as a function of sputtering power density. Chemical bonding and microstructure of the carbon thin films were investigated using electron energy loss spectroscopy (EELS) and Raman spectroscopy. Films grown at a lower power density were found to have more sp(sup 3)-bonded atomic sites and larger graphite microcrystals than films produced at higher sputtering power densities. DOE

N90-24351*# Purdue Univ., West Lafayette, IN.
INDUSTRIAL PLASTICS WASTE: IDENTIFICATION AND SEGREGATION
Edward L. Widener *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 1- (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11C

N90-24352*# Norfolk State Univ., VA. Dept. of Chemistry and Physics.
DIELECTRIC DETERMINATION OF THE GLASS TRANSITION TEMPERATURE (T SUB g)
Heidi R. Ries *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 7-11 (For primary document see N90-24350 18-23)
(Contract NCC1-90)
Avail: NTIS HC A09/MF A02 CSCL 11C

N90-24353*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DYNAMIC MECHANICAL ANALYSIS OF POLYMERIC MATERIALS
Kristen T. Kern, Wynford L. Harries (Old Dominion Univ., Norfolk, VA.), and Sheila Ann T. Long *In its* National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 13-18 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11C

N90-24359*# Purdue Univ., West Lafayette, IN.
RECYCLING WASTE-PAPER
Edward L. Widener *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 65-69 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11C

N90-24360*# Purdue Univ., Elkhart, IN.
PIEZOELECTRIC AND PYROELECTRIC EFFECTS OF A CRYSTALLINE POLYMER
Nikhil K. Kundu and Malay Kundu (Adams, John High School, South Bend, IN) *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 71-76 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11C

N90-24362*# University of Southern Colorado, Pueblo.
RUBBERLIKE ELASTICITY EXPERIMENT
Richard Greet and Robert Cobaugh *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 89-91 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11C

N90-24363*# Purdue Univ., Elkhart, IN.
THE EFFECT OF THERMAL DAMAGE ON THE MECHANICAL PROPERTIES OF POLYMER REGRINDS
Nikhil K. Kundu *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 93-99 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11C

N90-24366*# Anne Arundel Community Coll., Arnold, MD.
TENSILE AND SHEAR STRENGTH OF ADHESIVES
Kenneth A. Stibolt *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 115-117 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 11C

N90-24471# European Space Tribology Lab., Risley (England). AEA Technology.
THE ADVANTAGES AND LIMITATIONS OF SPUTTERED MOLYBDENUM DISULPHIDE AS A SPACE LUBRICANT
E. W. Roberts *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 59-65 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

N90-24472# Nissan Motor Co. Ltd., Tokyo (Japan). Materials Research Lab.
INVESTIGATION OF LUBRICATION CHARACTERISTICS OF MoS2 FILMS IN SPACE ENVIRONMENT
M. Arita, Y. Yasuda, T. Aikawa, M. Akiyama, and N. Ohmae (Osaka Univ., Japan) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 67-71 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

N90-24495# European Space Tribology Lab., Risley (England). AEA Technology.
THE PERFORMANCE OF PTFE, LEAD, AND MoS2 AS LUBRICANT FILMS FOR BALL BEARINGS OPERATING IN VACUUM AT 20 K
S. G. Gould and E. W. Roberts *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 223-228 Sponsored by ESTEC (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

N90-24501# Centre Suisse de Documentation dans le Domaine de la Microtechnique, Neuchatel.
THICK AND COMPACT MoS2 COATINGS
C. Mueller, C. Menoud, M. Maillat, and H. E. Hintermann *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 267-271 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

N90-25046*# Tennessee Univ., Knoxville. Dept. of Chemical Engineering.
MORPHOLOGICAL CONTROL OF INTER-PENETRATING POLYMER NETWORKS Abstract Only
Marion Hansen *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 76 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 11C

N90-25069*# Akron Univ., OH. Dept. of Polymer Engineering.
PROCESSING POLYMERIC POWDERS
James L. Throne *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 150-152 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 12A

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N90-24451# Naval Postgraduate School, Monterey, CA.
METALLIZED FUEL PARTICLE SIZE STUDY IN A SOLID FUEL RAMJET M.S. Thesis
James A. Nabity Sep. 1989 62 p
(AD-A220079) Avail: NTIS HC A04/MF A01 CSCL 21/4

Particle size measurements were obtained at the grain exit and nozzle entrance in a solid fuel ramjet combustor using a boron based fuel. The particle size distributions at the aft end of the fuel grain were generally quadra-modal, with mode peaks at 2, 4, 15, and 25 to 45 microns. At the nozzle entrance the distributions were tri-modal, due to the complete oxidation of the 2 micron particles. Sauter mean diameter and the size of the largest agglomerates increased with increasing equivalence ratio (or grain length), indicating that the longer grains result in more surface agglomeration. Combustion efficiency increased with equivalence ratio. A direct correlation of particle size alone with combustion efficiency was not obvious and may require an accurate measurement of particle concentration. GRA

N90-24452# AeroChem Research Labs., Inc., Princeton, NJ.
PRODUCTION AND COATING OF PURE BORON POWDERS Final Report, 1 Sep. 1989 - 28 Feb. 1990
Hartwell F. Calcote, Robert J. Gill, Charles H. Berman, and William Felder 30 Mar. 1990 59 p
(Contract N00014-89-C-0246)
(AD-A220272; AEROCHEM-TP-489) Avail: NTIS HC A04/MF A01 CSCL 21/2

Boron is an attractive fuel because of its potential energy release with oxygen and because of its lightweight. It is, however, difficult to incorporate into a fuel system because an oxide layer forms on the surface and suppresses combustion. A new synthesis process has been evaluated for the preparation of boron fuel particles coated with titanium. The titanium coating prevents oxide from forming and aids in the combustion. Pure boron particles are produced by reaction of sodium with boron trichloride, the products expanded through a supersonic nozzle, in which titanium tetrachloride is added to produce titanium. The titanium coats the boron particle. The coated particles are separated from the gaseous sodium chloride by a new type supersonic virtual impact collector. The process has been analyzed by computer modeling and an apparatus has been designed to test the concept and prepare coated boron fuel particles for evaluation. GRA

N90-24453# Coordinating Research Council, Inc., Atlanta, GA.
CRC LOW- AND INTERMEDIATE-TEMPERATURE DRIVEABILITY PROGRAM USING GASOLINE-ALCOHOL BLENDS
Feb. 1990 195 p
(CRC Proj. CM-118-86/87)
(AD-A221321; CRC-568) Avail: NTIS HC A09/MF A02 CSCL 21/4

A cooperative test program was conducted in 1986 and 1987 to characterize the relationship between cold-start and warmup driveability and gasoline volatility parameters of T10, T50, and T90 distillation temperatures. Hydrocarbon-only and gasoline-alcohol blends were tested. The test program was divided into two phases: the intermediate-temperature (40 F to 60 F) phase was conducted in Paso Robles, California, from October 13 through November 14, 1986; and the low-temperature (10 F to 40 F) phase was conducted in Brainerd, Minnesota, from January 19 through February 18, 1987. Driveability was better with high volatility fuels, and at intermediate ambient temperatures. Fuel-injected vehicles exhibited better driveability than carbureted vehicles. Driveability with hydrocarbon-only gasolines with significantly better than gasoline-ethanol blends, and gasoline-methanol:TBA blends. Compared with gasoline-methanol:TBA blends gasoline-ethanol

blends gave significantly better driveability. Regression equations which related volatility to vehicle cold-start and warmup driveability were developed for both temperature phases. GRA

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.
For biological materials see *55 Space Biology*.

N90-24306# Technische Hochschule, Darmstadt (Germany, F.R.).
EXPERIENCES WITH AND ERROR HANDLING IN A KNOWLEDGE BASE ASSISTED SYSTEM FOR PAYLOAD EXPERIMENT AUTOMATION
G. Kegel and H. Tolle *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 183-189 Sponsored by BMFT (For primary document see N90-24280 18-12)
Copyright Avail: NTIS HC A19/MF A03; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders

N90-24496# University Coll. of North Wales, Bangor. School of Electronic Engineering Science.
PROGRESS IN THE DESIGN OF A MICROGRAVITY FACILITY FOR IN-ORBIT EXPERIMENTS
A. R. Owens, D. I. Jones, R. G. Owen, G. Roberts, and A. A. Robinson (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 229-234 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

N90-24506# Polytechnical Univ. of Madrid (Spain). Dept. of Aerospace Materials and Production.
DESIGN AND MANUFACTURING OF AN APTF TO TEST FLUID BEHAVIOUR IN MICROGRAVITY ENVIRONMENT
P. Rodriguez, A. Sanz, J. M. Perales, and A. P. Sanz *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 299-304 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N90-24454*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
MONOCOQUE STRUCTURE FOR THE SKITTER THREE-LEGGED WALKER Advanced Design Program
Robert N. Bansek, Andrew J. Booth, Steven A. Daneman, James A. Dresser, Todd G. Haney, Gregory R. Johnson, Eric C. Lindzen, Robert C. Montgomery, and Andrew L. Warren Jun. 1988 56 p
(Grant NGT-21-002-800)
(NASA-CR-184635; NAS 1.26:184635; ME-4182) Avail: NTIS HC A04/MF A01 CSCL 13B

The SKITTER 2 design is a monocoque version of the proposed lunar three-legged walker. By the definition of monocoque, the body and legs are a shell with no internal ribbing or supports added for absorbing stresses. The purpose of the monocoque is to encase the elements used for power transmission, power supply, and control of the motion. The material for the structure is a vinyl ester resin, Derakane 8084. This material is easily formable and locally obtainable. The body consists of a hexagonally shaped cylinder with truncated hexagonal pyramids on the top and botton. The legs are eight inch diameter cylinders. The legs are comprised of a tibia section and a femur section. The SKITTER 2 is powered by six actuators which provide linear forces that are transformed into rotary torques by a series of chains and sprockets. The joints connect the femur to the body and the tibia to the femur. Surrounding the joints are flexible rubber hoses that fully encase the chains and sprockets. The SKITTER 2 is capable of walking upside down, righting itself after being overturned, and has the ability to perform in many environments. Applications for this walker include lunar transport or drilling, undersea exploration, and operation in severe surroundings such as arctic temperatures or high radiation. Author

N90-24455*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
MECHANICAL DESIGN ENGINEERING. NASA/UNIVERSITY ADVANCED DESIGN PROGRAM: LUNAR BULK MATERIAL TRANSPORT VEHICLE
Paul Daugherty, Stewart Griner, Alan Hendrix, Chris Makarov, Stephen Martiny, Douglas Ralph Meyhoefer, Cody Claxton Platt, John Sivak, and Elizabeth Fitch Wheeler Jun. 1988 131 p Original contains color illustrations
(Grant NGT-21-002-800)
(NASA-CR-184926; NAS 1.26:184926; ME-4182) Avail: NTIS HC A07/MF A01; 2 functional color pages CSCL 13B

The design of a Lunar Bulk Material Transport Vehicle (LBMTV) is discussed. Goals set in the project include a payload of 50 cubic feet of lunar soil with a lunar of approximately 800 moon-pounds, a speed of 15 mph, and the ability to handle a grade of 20 percent. Thermal control, an articulated steering mechanism, a dump mechanism, a self-righting mechanism, viable power sources, and a probable control panel are analyzed. The thermal control system involves the use of small strip heaters to heat the housing of electronic equipment in the absence of sufficient solar radiation and multi-layer insulation during periods of intense solar radiation. The entire system uses only 10 W and weighs about 60 pounds, or 10 moon-pounds. The steering mechanism is an articulated steering joint at the center of the vehicle. It utilizes two actuators and yields a turning radius of 10.3 feet. The dump mechanism rotates the bulk material container through an angle of 100 degree using one actuator. The self-righting mechanism consists of two four bar linkages, each of which is powered by the same size actuator as the other linkages. The LBMTV is powered by rechargeable batteries. A running time of at least two hours is attained under a worst case analysis. The weight of the batteries is 100 pounds. A control panel consisting of feedback and control instruments is described. The panel includes all critical information necessary to control the vehicle remotely. The LBMTV is capable of handling many types of cargo. It is able to interface with many types of removable bulk material containers. These containers are made to interface with the three-legged walker, SKITTER. The overall vehicle is about 15 feet in length and has a weight of about 1000 pounds, or 170 lunar pounds. Author

N90-24456*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
LUNAR MATERIAL TRANSPORT VEHICLE
Charles D. Fisher, Douglas Lyons, W. Allen Wilkins, Jr., and Harry C. Whitehead, Jr. Mar. 1988 96 p
(Grant NGT-21-002-800)
(NASA-CR-185929; NAS 1.26:185929; ME-4182) Avail: NTIS HC A05/MF A01 CSCL 13B

The proposed vehicle, the Lunar Material Transport Vehicle (LMTV), has a mission objective of efficient lunar soil material transport. The LMTV was designed to meet a required set of performance specifications while operating under a given set of constraints. The LMTV is essentially an articulated steering, double-ended dump truck. The vehicle moves on four wheels and has two identical chassis halves. Each half consists of a chassis frame, a material bucket, two wheels with integral curvilinear synchronous motors, a fuel cell and battery arrangement, an electromechanically actuated dumping mechanism, and a powerful microprocessor. The vehicle, as designed, is capable of transporting up to 200 cu ft of material over a one mile round trip per hour.

The LMTV is capable of being operated from a variety of sources. The vehicle has been designed as simply as possible with attention also given to secondary usage of components. Author

N90-24457*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
THREE LEGGED WALKING MOBILE PLATFORM: KINEMATIC AND DYNAMIC ANALYSIS AND SIMULATION Advanced Design Program
Gary V. McMurray and Brice K. MacLaren Jun. 1988 142 p
(Grant NGT-21-002-800)
(NASA-CR-184929; NAS 1.26:184929) Avail: NTIS HC A07/MF A01 CSCL 13B

The three legged walker is proposed as a mobile work platform for numerous tasks associated with lunar base site preparation and construction. It is seen as one of several forms of surface transportation, each of which will be best suited for its respective tasks. Utilizing the principle of dynamic stability and taking advantage of the Moon's gravity, it appears to be capable of walking in any radial direction and rotating about a point. Typical curved path walking could involve some combination of the radial and rotational movements. Comprised mainly of a body, six actuators, and six moving parts, it is mechanically quite simple. Each leg connects to the body at a hip joint and has a femur, a knee joint, and a tibia that terminates at a foot. Also capable of enabling or enhancing the dexterity of a series of implements, the walker concept provides a mechanically simple and weight efficient means of drilling, digging, mining, and transporting cargo, and performing other like tasks. A proof of principle machine demonstrated the feasibility of the walking concept. Author

N90-24458*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
VERTICALLY RECIPROCATING AUGER
Mark Etheridge, Scott Morgan, Robert Fain, Jonathan Pearson, Kevin Weldi, and Stephen B. Woodrough, Jr. Mar. 1988 67 p
(Grant NGT-21-002-800)
(NASA-CR-182822; NAS 1.26:182822; ME-4182) Avail: NTIS HC A04/MF A01 CSCL 13B

The mathematical model and test results developed for the Vertically Reciprocating Auger (VRA) are summarized. The VRA is a device capable of transporting cuttings that result from below surface drilling. It was developed chiefly for the lunar surface, where conventional fluid flushing while drilling would not be practical. The VRA uses only reciprocating motion and transports material through reflections with the surface above. Particles are reflected forward and land ahead of radially placed fences, which prevent the particles from rolling back down the auger. Three input wave forms are considered to drive the auger. A modified sawtooth wave form was chosen for testing, over a modified square wave or sine wave, due to its simplicity and effectiveness. The three-dimensional mathematical model predicted a sand throughput rate of 0.2667 pounds/stroke, while the actual test setup transported 0.075 pounds/stroke. Based on this result, a correction factor of 0.281 is suggested for a modified sawtooth input. Author

N90-24459*# Texas Univ., Austin. Dept. of Mechanical Engineering.
CONCEPTUAL DESIGN AND ANALYSIS OF ROADS AND ROAD CONSTRUCTION MACHINERY FOR INITIAL LUNAR BASE OPERATIONS
Jeffrey L. Sines, Joel Banks, and Keyanoush Efatpenah 1990 206 p
(Contract NASw-4435)
(NASA-CR-186673; NAS 1.26:186673) Avail: NTIS HC A10/MF A02 CSCL 13B

Recent developments have made it possible for scientists and engineers to consider returning to the Moon to build a manned lunar base. The base can be used to conduct scientific research, develop new space technology, and utilize the natural resources of the Moon. Areas of the base will be separated, connected by a system of roads that reduce the power requirements of vehicles traveling on them. Feasible road types for the lunar surface were analyzed and a road construction system was designed for initial lunar base operations. A model was also constructed to show the system configuration and key operating features. The alternate designs for the lunar road construction system were developed in four stages: analyze and select a road type; determine operations and machinery needed to produce the road; develop machinery configurations; and develop alternates for several machine components. A compacted lunar soil road was selected for initial lunar base operations. The only machinery required to produce this road were a grader and a compactor. The road construction system consists of a main drive unit which is used for propulsion, a detachable grader assembly, and a towed compactor. Author

N90-24460# Columbia Univ., New York, NY. Microelectronics Sciences Labs.
DIRECT WRITING OF MICROSTRUCTURES FOR SOLID-STATE ELECTRONICS Final Technical Report, 15 Jun. 1986 - 14 Jun. 1989
Richard M. Osgood, Dragan Podlesnik, and Rob Scarmozzino Mar. 1990 42 p
(Contract F49620-86-C-0067; ARPA Order 9107)
(AD-A220996; AFOSR-90-0512TR) Avail: NTIS HC A03/MF A01 CSCL 13/8

Progress in using laser chemical processing for several applications in microelectronics and integrated optics is described. These applications are direct writing of metal interconnects on silicon integrated circuits; laser doping, etching and surface modification of GaAs, and fabrication of light guiding components for integrated optics. GRA

N90-24461# Air Force Weapons Lab., Kirtland AFB, NM.
PROOF OF PRINCIPLE STUDY OF THICKNESS MEASUREMENTS USING CHARACTERISTIC X RAY LINE RATIO TECHNIQUES Final Report, Dec. 1988 - Sep. 1989
Kerry W. Habiger and Charles Stein Mar. 1990 48 p
(AF Proj. ILIR)
(AD-A221113; WL-TR-89-61) Avail: NTIS HC A03/MF A01 CSCL 20/5

Two characteristic x ray line ratio techniques are experimentally investigated. One technique uses the ratio of the characteristic L x ray line to the characteristic K alpha x ray line of the substrate. The other technique uses the ratio between one characteristic x ray line of the substrate and one characteristic x ray line of the thin film overlay. Experimental measurements were taken for both techniques by bombarding a coated sample with electrons and measuring the ratio of the areas under the characteristic line peaks. The samples used in the experiment consisted of a copper substrate coated with aluminum and molybdenum substrate coated with aluminum. The data are presented by plotting the characteristic x ray line ratios versus the thin film thickness from 400 to 7000 angstrom for 20, 25 and 30 keV electron bombardment. Based upon these experiments, it was found that the ratio of the characteristic x ray lines from the substrate (L/K alpha ratio) is not suitable for thin film measurements. However, the ratio technique that uses one x ray line from the substrate and one x ray line from the thin film overlay produced large ratio changes (80 percent) over the thickness range of 5000 angstrom. This ratio was independent of accelerating electron energy and was an inverse function of the overlay thickness. GRA

N90-24462# European Space Agency, Paris (France).
FOURTH EUROPEAN SPACE MECHANISMS AND TRIBOLOGY SYMPOSIUM
W. R. Burke, comp. Mar. 1990 306 p In ENGLISH and FRENCH Symposium held in Cannes, France, 20-22 Sep. 1989; sponsored in cooperation with Aerospatiale, CNES, and ESA
(ESA-SP-299; ISBN-92-9092-038-6; ISSN-0379-6566; ETN-90-96977) Copyright Avail: NTIS HC A14/MF A02

Various aspects of spacecraft design and research are addressed. Rendezvous and docking are considered. Manipulators and robot grippers are discussed. Tribology is given particular attention. The areas of tribology discussed include consideration

of surface modifications, mechanisms such as the wear of cryomechanisms and gold-plated contacts and the study of ball bearings for space use. Scanning and pointing mechanisms are described. Extravehicular mechanisms, suits, and tools are discussed. Deployment mechanisms are described. Attachment and drive mechanisms are described. For individual titles, see N90-24463 through N90-24508.

N90-24463# Lockheed Aircraft Corp., Palo Alto, CA.
DESIGN CONSIDERATIONS FOR PRECISION AND RELIABILITY IN SPACE MECHANISMS **c37**
Kenneth R. Lorell *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 3-10 (For primary document see N90-24462 18-31)
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Design considerations able to meet the requirements imposed by the improved sensitivity of focal-plane instrumentation and infrared systems are discussed. For infrared systems, the performance of the instrumentation requires that the entire optical train be cooled to cryogenic temperatures. For visible wavelength systems, the antenna, or primary mirror, must be made as large as possible. Different design solutions adopted in cryogenic and in large aperture optical system spececraft are outlined. Dynamic range and sensitivity, smoothness of operation, power consumption and thermal-energy dissipation are taken into consideration in the analysis of these systems. The Cryogenic Limb Array Etalon Spectrometer (CLAES) is used as an example of the new design approach necessary. The difficulties inherent in testing such sophisticated and sensitive instruments are discussed. ESA

N90-24464# Sener S.A., Las Arenas (Spain).
CONCEPT DESIGN FOR HERMES DOCKING/BERTHING MECHANISM **c37**
J. J. GonzalezVallejo *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 13-18 (For primary document see N90-24462 18-31)
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Docking between the Hermes Space Station Freedom or the Columbus Free Flying Laboratory is discussed. The docking mechanism which will both allow Hermes to connect with the target spacecraft and dissipate the impact energy is described. The docking mechanism moves the two vessels closer together and provides a pressurized passageway for crew and goods. The different requirements, needs and strategies involved with such a docking mechanism are discussed. The main structural and mechanical assemblies making up the docking mechanism are described. ESA

N90-24465# Societe Anonyme Belge de Constructions Aeronautiques, Brussels.
FLUID CONNECTORS FOR OPERATION IN SPACE **c37**
G. Bekaert and Neil Cable (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 19-23 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

Two different mechanisms carrying fluid connectors are described. Fluid connectors and subassemblies used for refilling/refueling in docking/berthing systems are discussed. Fluid connectors and subassemblies for active thermal control in orbital replacement units are outlined. The guidelines and verification tests used in the selection of the concepts are described. Breadboard test results, confirming the suitability of the design concept are presented. The need to further minimize the mass and size of the connectors is stressed. Tests of leakage and ageing in a thermal vacuum environment are called for. ESA

N90-24466# Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer Werkstoffe.
SHAPE MEMORY ALLOYS FOR ROBOT GRIPPERS AND MECHANICAL HANDS **c26**
K. Escher and E. Hornbogen *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 27-32 Sponsored by DFVLR (For primary document see N90-24462 18-31)
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The use of shape memory alloys for grippers and actuators is proposed. These alloys, able to carry out complicated and versatile motions due to heating or cooling without application of external stress require no lubrification. The martensitic phase transformations which provide the alloy with its shape memory are discussed. Three different characteristics of shape memory behavior such as training procedure, composite principle or application of an external recovering force are described. The problems to be solved before an engineering use of shape memory can be made are identified. These include low efficiency, thermal and mechanical fatigue of the alloy and very sluggish reverse motion during the cooling process. ESA

N90-24467# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
A COMPACT JOINT FOR THE ROTEX MANIPULATOR **c37**
K. Priesett and W. Beckert *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 33-38 (For primary document see N90-24462 18-31)
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The Robotics Technology Experiment (ROTEX), part of the German D2 Spacelab mission scheduled for February 1992 is described. The rotary joints of the small six axis manipulator arm are presented. Because of the limited space inside the spacelab rack, the joints must be very compact and provide high stiffness and strengh. A summary of the major requirements, a description of two joint configurations, and the basic actuator construction are presented. Component performances and the results of sets conducted on a representative prototype joint are presented. ESA

N90-24468# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).
GALACTICAL ULTRA WIDE ANGLE SCHMIDT SYSTEM **c74**
T. Miski and K.-H. Weber *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 39-44 (For primary document see N90-24462 18-31)
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The Galactical Ultrawideangle Schmidt System (GAUSS) camera is described. The camera is designed for operation in a wavelengh range extending far into vacuum ultraviolet. A three axis stabilized platform with a control range of plus or minus five degrees integrated into the camera design is described. The stages involved in developing the camera are outlined. The unit is designed to be carried on the D2 Spacelab mission accommodated on the D2 Utility Support Structure (USS). Difficulties in meeting contradicting requirements of high precision and wide temperature ranges for a variety of mechanisms with quite different performances are discussed. ESA

N90-24469# Institut National des Sciences Appliquees, Lyon (France). Lab. de Mecanique des Contacts.
INTERFACE TRIBOLOGY AND SPACE CONDITIONS **c37**
Y. Berthier, L. Flamand, M. Godet, and L. Petitjean (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 47-51 Sponsored by CNES (For primary document see N90-24462 18-31)
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The mechanical and physical factors which govern contact conditions and which are different in space and in vacuum are discussed in the light of interface tribology. The role of lubricants is discussed. A quick review of interface tribology is presented. A program to be carried out on a special test device modified to operate under vacuum, and capable of simulating the effect of contact geometry, load, speed and environment on the behavior of low vapor pressure oils and greases is described. The possibility of extrapolating laboratory results to industrial applications is discussed. ESA

N90-24470# Centre Suisse de Documentation dans le Domaine de la Microtechnique, Neuchatel.
TRIBOLOGICAL PROPERTIES OF PVD-APPLIED MoS2 COATINGS USED ON SPACE MECHANISMS **c37**
M. Maillat, C. Menoud, H. E. Hintermann, and J. F. Patin (Aerospatiale, Cannes, France) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 53-57 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

Coatings of the dry lubricant molybdenum disulfide applied by sputtering on space mechanisms are discussed. Some tribological behavior is described in relation to the mechanism operation. Friction and wear measurements carried out using pin and disk tribometers are discribed. The roles played by relative humidity, contamination by wear particles, and in-vacuo running-in are discussed. The role that the MoS2 lubricant plays on a one operation single-shot mechanism such as a solar array hold-on and release mechanism is contrasted with the role of lubricant in longlife mechanisms such as ball bearings. ESA

N90-24471# European Space Tribology Lab., Risley (England). AEA Technology.
THE ADVANTAGES AND LIMITATIONS OF SPUTTERED MOLYBDENUM DISULPHIDE AS A SPACE LUBRICANT **c27**
E. W. Roberts *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 59-65 (For primary document see N90-24462 18-31)
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The sensitivity of thin films of molybdenum disulfide to the conditions under which they are employed is discussed. These conditions, which encompass such variables as load, sliding speed and vacuum pressure can seriously affect the ultra-low-friction behavior of the lubricant film. The tribological properties of sputtered MoS2 under the varied conditions of operation likely to be experienced in space are studied. Gaining a better understanding of its advantages and limitations as a spacecraft lubricant is the goal of the study. ESA

N90-24472# Nissan Motor Co. Ltd., Tokyo (Japan). Materials Research Lab.
INVESTIGATION OF LUBRICATION CHARACTERISTICS OF MoS2 FILMS IN SPACE ENVIRONMENT **c27**
M. Arita, Y. Yasuda, T. Aikawa, M. Akiyama, and N. Ohmae (Osaka Univ., Japan) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 67-71 (For primary document see N90-24462 18-31)
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Degradation of surface materials due to exposure to atomic oxygen (AOx) irradiation is discussed. Molybdenum disulfide bonded films used as lubricating agents are exposed to an AOx beam. The effects of exposure on their lubricating performance is examined using a pin/disk sliding test under vacuum conditions. Exposure to the AOx beams is shown to induce significant changes in lubricating performance. Atomic oxygen reacts with MoS2, producing molybdenum oxides MoS2 and MoS3 at the surface. It is concluded that these chemical reactions must be taken into account if long-lived operation is to be assured. ESA

N90-24473# British Aerospace Public Ltd. Co., Bristol (England).
MULTI-APPLICATION SCANNING MECHANISM **c37**
M. E. Humphries and M. P. Hyam *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 75-80 Sponsored by United Kingdom MET Office (For primary document see N90-24462 18-31)
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A scanning mechanism suitable for a variety of scientific payloads is described. Concept selection and the design and development testing of an engineering model of the mechanism are described. The design concept is based on a scan platform mounted on bearings within a housing, the platform being driven through an anti backlash gear train by a brushless dc motor. A closed loop control system, using a high resolution position transducer and microprocessor, drives the platform in a predetermined scan pattern. The modular design of mechanism allows for optional selection of a momentum compensation wheel and a reversible, double-acting bearing off-load device that can protect the bearings of the scan platform and the momentum wheel. ESA

N90-24474# Marconi Space Systems Ltd., Portsmouth (England).
A COMMUNICATIONS ANTENNA POINTING SYSTEM (CAPS): A MODULAR APPROACH **c37**
P. J. Whiteman *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 81-85 (For primary document see N90-24462 18-31)
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CAPS, a modular antenna pointing mechanism concept is presented. The design is capable of meeting a wide range of requirements with minimum modification. Ways in which the development and qualification of the mechanism were carried out while minimizing costs are described. The mechanical aspects of the antenna pointing mechanism are described. The need for communication satellites to be able to point beams at any selected spot on the Earth is stressed. The demand for pointing mechanisms capable of working in a space environment while supporting a two meter reflector is predicted to increase. ESA

N90-24475# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
PRECISION POINTING AND LOCKING CAPABILITIES COMBINED BY A LINEAR ACTUATOR **c37**
M. Schmid and M. Gohl *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 87-92 (For primary document see N90-24462 18-31)
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A design description of Linear Actuator (LA) developed as part of the Millimeterwave Atmospheric Sounder (MAS) experiment is presented. The LA was designed taking into consideration the special Shuttle safety requirements and boundary conditions for manned missions. A launch locking device included in the design is described. During launch and reentry high axial loads must be transferred via the actuator originating from the antenna which is movable around its elevation axis. During the mission, the actuator is used for precision scanning and pointing of the antenna. ESA

N90-24476# Aerospatiale, Cannes (France).
WEARING OF CRYOMECHANISMS AT 4 K **c37**
Gerard Luciano *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 95-99 (For primary document see N90-24462 18-31)
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Pollution due to wear of the mechanisms controlling the motion of spaceborne optics is addressed. Cleanliness of the optical components being crucial to the image quality produced, ways to minimize optical pollution due to coupling gears and other mechanisms are discussed. Comparative tests are carried out on several types of mechanisms in order to choose that which has the most long lasting, clean operation. Applications of this research to the development of the optical bench used in the infrared camera flown aboard the Infrared Space Observatory (ISO) are discussed. ESA

N90-24477# Toshiba Corp., Kanagawa (Japan).
STUDY OF BALL BEARINGS FOR SPACE USE **c37**
T. Kawamura, T. Honda, N. Kawashima, M. Nishimura, and K. Seki (National Aerospace Lab., Tokyo, Japan) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 101-107 (For primary document see N90-24462 18-31)
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The performance of ball bearings coated with sputtered molybdenum disulfide and assembled with a retainer of self-lubricating composite is described. A life test carried out at 150C is performed in vacuum. A second life test in which the

rotational speed was varied from 3 to 2000 RPM is carried out in a vacuum. A third life test is performed with high radial load (784N, 1586N) in vacuum. It is shown that in the early stages of testing, the bearing is mainly lubricated by the molybdenum disulfide films, after one million revolutions, the bearing is mainly lubricated by the transferred films of the retainer material. ESA

N90-24478# ETEL S.A., Motiers (Switzerland).
DESIGN AND USE OF HIGH SPEED SYNCHRONOUS MOTOR RUNNING IN AGGRESSIVE LIQUIDS **c37**
N. Wavre *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 109-115 (For primary document see N90-24462 18-31)
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Two applications of synchronous motors used to drive high speed pumps are presented. The first is developed for an Electric Propellant Pump System (EPPS). The system consists of a centrifugal pump assembled on the motor shaft. A nominal power of 2.5KW is obtained at 2500 rpm and a peak power of 3.5kW at 35000 rpm. A second motor developed for a Water Freon Wet Rotor Pump (WFPP) is described. The system consists of a centrifugal pump directly assembled on the shaft. The shaft is identified as the most critical part because it has to run in microgravity. Ways in which theses motors have been designed to run in aggressive liquids are described. ESA

N90-24479# Ecole Centrale de Lyon (France). Lab. de Technologie des Surfaces.
WEAR OF GOLD-PLATED CONTACTS: MICROSCOPIC ASPECTS, ROLE OF OXYGEN **c37**
M. Belin, T. LeMogne, and J. M. Martin *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 117-121 Sponsored in part by Centre National d'Etudes et Telecommunications (For primary document see N90-24462 18-31)
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The wear mechanisms of gold plated contacts during mating and unmating are discussed. Modifications of the mechanical and electrical properties due to the wear are described. The effects are simulated on two tribometers operating in different conditions. The physical properties of contact during friction are investigated in relation with analytical data obtained on wear debris and wear scars. The influence of the gas atmosphere is investigated. Tests are performed with different partial pressures of oxygen to determine the precise role of oxygen in the degradation process. ESA

N90-24480# Aerospatiale, Cannes (France).
MECHANISMS TO ASSEMBLE SPACE STRUCTURES IN EXTRAVEHICULAR ENVIRONMENT **c37**
Freddy Geyer *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 125-128 (For primary document see N90-24462 18-31)
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Development of space operated mechanisms requiring only low precision, low amplitude, low energy human motions to install, position and fasten into place different structural members is described. The technical and time-dependent difficulties involved in developing such mechanisms are described. The significant forces involved, the high stiffness specified and the prohibition of any play or backlash in the assembled structures has to be matched with the weakness of the cosmonaut's physical output. Development of the system over a six month period for use in the French-Soviet ARAGAZ mission is described. ESA

N90-24481# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Life Support and Habitability Section.
THE EUROPEAN EVA SPACESUIT MECHANISMS **c54**
Guido Albertini *In its* Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 129-133 (For primary document see N90-24462 18-31)
(Contract ESTEC-7790/88/NL/PB(SC))
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The Extravehicular Activities (EVA) spacesuit developed by ESA and ESTEC is described. Protection, mobility, dexterity, visibility, pressurization, atmosphere regulation and thermal control functions are discussed. The shoulder joint, bearings and other joints in the suit are described and shown in diagrammatic form. The gloves and spacesuit rear entry door mechanisms are described and shown in diagrammatic form. The fan/water separator is described and shown in diagrammatic form. The designs represented constitute the technical baseline of the European EVA spacesuit. ESA

N90-24482# Tecnospazio S.p.A., Milan (Italy).
EVA POWER TOOL PROTOTYPE **c37**
Maurizio Artesani *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 135-140 (For primary document see N90-24462 18-31)
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The design, features and performance of a servicing aid tool developed by Technospazio is described. The tool, developed as part of the ESA Extravehicular Activity (EVA) and robotic servicing aids' program, is destined for use on both manned and man tended permanent orbiting structures. The main features of the tool are tested in a neutral buoyancy facility. The results are satisfactory both from the point of view of functional performance and ergonomics. Ways in which to further improve the tool are presented. ESA

N90-24483# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
MECHANISMS ADD FOLDABILITY TO ROSAT SOLAR PANELS **c37**
H. Heimerdinger and P. H. Pawlowski (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany, F.R.) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 143-148 (For primary document see N90-24462 18-31)
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Modifications carried out on the ROSAT (x ray satellite) solar panels to adapt them to changes made in the launch carrier are outlined. The requirements, design, assembly, and tests of the new solar panel mechanisms are described. Extensive investigation of the influence of humidity on the friction torque of the MoS2 lubricated ball bearings is carried out. It is concluded that 80 percent air humidity raises the torque to 7 Ncm which corresponds to approximately 275 percent of dry torque. Drying the hinge reduced its torque to 3 Ncm or approximately 110 percent dry torque. ESA

N90-24484# Cambridge Univ. (England). Dept. of Engineering.
A CABLE-RIGIDIZED 3D PANTOGRAPH **c37**
A. S. K. Kwan and S. Pellegrino *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 149-154 Sponsored by Cambridge Commonwealth Trust, England (For primary document see N90-24462 18-31)
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A deployable mast consisting of a three dimentional pantograph formed by a set of rods hinged together is described. Two active cables control the deployment and prestressing of the pantograph. Several passive cables remain slack until the pantograph folds out into its fully deployed configuration. A technique for analyzing both the deployment of the mast and the response to external loads of the fully deployed mast is outlined. The transition from a bending-dominated pantograph to a braced truss is shown to be an effective way of achieving large increases in stiffness when the fully-deployed configuration is reached. ESA

N90-24485# Aerospatiale, Cannes (France).
ADELE: DEPLOYMENT HINGE USING WRAPAROUND STRIPS [ADELE: ARTICULATION DE DEPLOIEMENT A LAMES D'ENROULEMENT] **c37**
Eric Blanc *In* ESA, Fourth European Space Mechanisms and

Tribology Symposium Mar. 1990 p 155-158 (For primary document see N90-24462 18-31)
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The ADELE hinge is described. The hinge is designed to comply with the principles of the appendage deployment concept developed by Aerospatiale. The AMEDE (Amelioration des Mecanismes de Deploiement) concept aims to increase simplicity and functional reliability. The concept allows for deployment without synchronization or speed regulation devices. It calls for the use of hinges such as ADELE with low motor or resistive torques. The conceptual and functional principles behind the ADELE hinge are presented along with the hinge's main characteristics. The Amadeus experiment whose implentation on board the MIR orbital station led to inflight validation of the AMEDE concept is described. ESA

N90-24486# Aeritalia S.p.A., Turin (Italy). Space Systems Group.
SOME REMARKS ON A HINGE ACTUATOR FOR LARGE SPOT ANTENNA ARM DEPLOYERS **c37**
Edmondo Turci *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 159-166 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

Soft and hard mounted ball bearing duplex hinge assemblies are analyzed. Assembly of such hinges with redundant provisions taking vibrational and thermal environments into consideration is discussed. A method is proposed for calculating the friction torque on the ball bearings compared to experimental data. The method is applied to the design of a hinge actuator for a large spot antenna arm deployer. The configuration makes use of an articulated quadrilateral link and spring. The rotation of the arm is actuated without any speed damper. ESA

N90-24487# Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (Germany, F.R.).
THE LARGE WHEEL ACTUATOR LDR 100-0: DEVELOPMENT STATUS AND TEST RESULTS **c37**
H. Heimel *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 169-174 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

A large wheel intended to provide an inertial actuator for attitude control and navigation of large space platforms is described. With an angular momentum capacity of 1000 Nms, it is particularly aimed at the needs of the resource module of the Columbus Free Flying Laboratory. Details of the manufacturing and testing stages of this engineering model are presented. Tests results and performance data are listed. Further developmental steps needed to produce large wheel actuator flight models in the future are discussed. ESA

N90-24488# Sener S.A., Las Arenas (Spain).
CLAMPING DEVICE FOR PRESSURIZED MODULE RADIATOR PANEL **c37**
J. J. GonzalezVallejo, J. Arino, and L. Gutierrez *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 175-180 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

A clamping system for the pressurized module radiator panels of the Columbus Space Station is described. The main functions of the clamping system are to support flight loads on the radiator, and provide the radiator panel with a quasi-isostatic, high stiffness supporting system while allowing panel dilation due to thermal changes. In-orbit radiator removal and installation either by means of a remote manipulator or by an astronaut working in an extravehicular atmosphere are taken into consideration in the design of the clamping system. ESA

N90-24489# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
ANALYSIS AND TEST INTERACTION IN THE DEVELOPMENT OF A HOLD DOWN AND RELEASE MECHANISM **c37**
H.-J. Luhmann and C.-Ch. Etzler *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 181-186 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

The features of the hold-down and release mechanism used to hold the folded synthetic aperture radar antenna onboard the ESA Remote Sensing Satellite (ERS-1) during launch are described. Six hinged clamps are released in orbit via a system of springs and cables connected to a pyrotechnical device. Improvements in the mechanism introduced during the early design stage on the basis of analytical investigations and component tests are highlighted. Special emphasis is given to the interaction between analysis and test results. Results from subsystem tests are considered. ESA

N90-24490# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Dept. of Mechanical Systems
THE TETRAHEDRAL WEDGE ATTACHMENT MECHANISM **c37**
Neil Cable *In its* Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 187-194 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

A device providing precision location of an item by the action of a single locking force is described. It also allows for immediate impedance-free removal of the item in a given direction once the locking force is removed. The joint, a simple re-usable mechanism, can be used for temporary or permanent fixation. Advantages of the device for certain applications are discussed. The replacement of equipment in orbit is one area where it could be useful. It is ideally suited as an end-effector in robotics where use can be made of the self-same joints for attachment of payloads to their storage and working positions. ESA

N90-24491# ETEL S.A., Motiers (Switzerland).
DESIGN AND USE OF BRUSHLESS dc MOTOR WITHOUT DETENT TORQUE **c33**
N. Wavre *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 197-201 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

Two applications of motors which cannot accept a residual detent torque due to the rotor magnets are presented. The first application concerns the joint mechanism of the Synchronous Meteorological Satellite/HERA project. The brushless torque motor drives a reversible harmonic drive with a high gear ratio of 500. The motor is designed to produce a stall torque of 3.0 Nm with a total imput power of 30 W for a total weight of 1.5 kg, with a no load speed of 500 rpm. The second application concerns the driving mechanism of an infrared sensor. The need to take all geometrical and magnetic parameters into consideration in designing space mechanisms is stressed. ESA

N90-24492# Mullard Space Science Lab., Dorking (England).
FURTHER DEVELOPMENT OF THE CRYOGENIC FABRY-PEROT INTERCHANGE MECHANISM FOR ISO LWS **c37**
T. J. Patrick, G. R. Davis, I. Furniss, W. A. Towlson, and R. C. Sidey (Custom Developments Ltd., Richmond, England) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 203-205 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

Improvements to the design of a cryogenic two-phase stepping motor and geared drive for the interchange of the two Fabry-Perot interferometers used in the Long Wavelength Spectrometer (LNS) of ESA's Infrared Space Observatory (ISO) are described. Improvements include the incorporation of redundant coils matched

to redundant drive circuits, sofware control of fast interchanges and improved ruggedness of the motor under vibration. Molybdenum disulfide coating has been applied to the hard-anodized gear teeth of the aluminum wheel, to the stainless steel driving pinion and to the ball bearing components. ESA

N90-24493# I.A.M. Rinaldo Piaggio, Finale Ligure (Italy).
A SPRING-ACTUATED SPIN AND EJECT DEVICE FOR INTERPLANETARY MISSIONS **c37**
V. Comparetto and P. A. Coste (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 207-214 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

The spin eject device designed to meet the requirements of the Cassini Mariner Mark 2 interplanetary mission is described. In the vicinity of Titan, Saturn's satellite, the orbiter will target and spin-eject a probe with a mass of 192 kg and 48 kg per square meter of inertia. It is to be ejected at 0.3 m/s and 10 rpm. Until launch is completed, the probe is attached to the spin eject device by four explosive bolts. After the firing of the bolts, a light Marman clamp holds the probe pressed to the spin eject device. The probe is then pushed away in a helicoidal motion by the spin eject device. Optimization of the device by dynamic analysis is described. Computer simulation of separation is carried out. Breadboard models are successfully tested including simulation of zero gravity in both nominal and failed conditions. ESA

N90-24494# British Aerospace Public Ltd. Co., Stevenage (England).
DESIGN AND DEVELOPMENT OF A SPACECRAFT STABILITY BOOM **c18**
J. Adams *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 217-222 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

The design and development of a low mass deployable spacecraft stability enhancement mechanism is described. The boom is designed to increase the spin axis stability of the Inmarsat 2 spacecraft for low fuel levels with minimum additional mass. The tip mass of the boom can be varied between two fixed limits in six equal increments. Deployment is achieved with an actuation factor in excess of four using spring assisted centrifugal forces. The developed design will deploy with an actuation factor of four with no spin and could therefore be used as an antenna deployment mechanism. ESA

N90-24495# European Space Tribology Lab., Risley (England). AEA Technology.
THE PERFORMANCE OF PTFE, LEAD, AND MoS2 AS LUBRICANT FILMS FOR BALL BEARINGS OPERATING IN VACUUM AT 20 K **c27**
S. G. Gould and E. W. Roberts *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 223-228 Sponsored by ESTEC (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

The performance of dry-lubricated angular contact ball bearings in a vacuum at 20K is investigated and compared with in-vacuo performance at room temperature. Comparative tests are performed using three dry lubricants, MoS2, lead, and polytetrafluoroethylene (PTFE). The torque performance of the MoS2 and lead lubricants at cryogenic temperature is undistinguishable from that at room temperature. With PTFE lubrication, both the torque and torque noise increase substantially on cooldown. The torque performance of combined MoS2 and PTFE lubrication also deteriorates on cooldown. ESA

N90-24496# University Coll. of North Wales, Bangor. School of Electronic Engineering Science.
PROGRESS IN THE DESIGN OF A MICROGRAVITY FACILITY FOR IN-ORBIT EXPERIMENTS **c29**
A. R. Owens, D. I. Jones, R. G. Owen, G. Roberts, and A. A. Robinson (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 229-234 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

Progress in the design of a microgavity isolation mount is described. A design for incorporation within a Columbus orbital replacement rack is presented. Non-contact position sensing and control and non-contact heat removal are essential factors in the design. Solutions to these problems are described. The design relies on the concept of a platform combined with a lock, cage and liner as an integrated design. The design of cooling fins is investigated in great detail. Design of a combined unit of non-salient sensors and actuators is described. ESA

N90-24497# Sener S.A., Las Arenas (Spain).
DETACHABLE INTERFACE MECHANISM **c37**
M. Sierra and C. Pascual *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 235-240 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

A detachable interface mechanism able to be incorporated in the large deployable/retractable solar arrays of the Columbus space station is described. The mechanism is designed to allow for easy removal and deplacement in orbit of solar arrays or parts of solar arrays which have become damaged or defective. The mechanism is designed to be actuated by a robot or by an astronaut. Photographs and diagrams of the detachable mechanism are presented. Static load and thermal test results are presented. The need to carry out further study in order to reduce the mass and improve the thermal requirements and constraints of the mechanism is stressed. ESA

N90-24498# Sira Inst. Ltd., Chislehurst (England).
SHUTTER MECHANISM FOR CONTROLLING THE EXPOSURE OF SAMPLES TO SOLAR RADIATION **c37**
W. A. Henton-Jones *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 241-248 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

A shutter mechanism used to control the amount of exposure of biological specimens to solar ultraviolet radiation is described. The biological specimens are carried aboard the Eureca 1 microgravity mission exobiology and radiation assembly. As the biological samples are installed in the facility shortly before launch, the shutter must be simple to install and check out. The modular approach used in the final design and the principal functional details of the shutter are described. ESA

N90-24499# Sira Inst. Ltd., Chislehurst (England).
MECHANISM FOR DEPLOYMENT AND RETRACTION OF BIOLOGICAL SAMPLES **c37**
W. A. Henton-Jones *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 249-256 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

The Exobiology and Radiation Assembly (ERA) carried aboard the Eureca 1 microgavity mission is discussed. A mechanism for exposing biological specimens to solar radiation is described. The spacecraft is Shuttle launched and retrieved. The samples must therefore be safely stowed after exposure. The mechanical aspects of the deployment mechanism are described and shown in diagrammatic and photographic form. Limit switches and the flexible cable link are shown. The influence of thermal considerations in the design process is discussed. ESA

N90-24500# Centre National d'Etudes Spatiales, Toulouse (France).
SPOT 4 MAGNETIC TAPE RECORDER MECHANISMS **c35**
A. Borrien, E. Vialatoux, J. L. Lhermet, and A. Didier (Schlumberger Industries, Velizy, France) *In* ESA, Fourth European Space

Mechanisms and Tribology Symposium Mar. 1990 p 257-265 In FRENCH; ENGLISH summary (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

A magnetic tape recorder mechanism developed for the French national Earth observation program is described. The system requirements of the mechanism and the main technical characteristics of the machine are presented. The different recorder subsystems and their technical functions are described. The components of the tape plate system subject to high mechanical effort, fatigue and overload in the thermal environment encountered during the mission are identified. The experimental program elaborated for the evaluation and qualification of these components is described. ESA

N90-24501# Centre Suisse de Documentation dans le Domaine de la Microtechnique, Neuchatel.
THICK AND COMPACT MoS2 COATINGS c27
C. Mueller, C. Menoud, M. Maillat, and H. E. Hintermann *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 267-271 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

DC magnetron sputtering of MoS2 on materials such as AISI 440C steel, Ti-Al-alloys, ceramics and fiberglass is described. The coating properties depend on the orientation of the substrates with respect to the target in the coating chamber. Long wear-life is obtained in tribological tests even with machined, unpolished substrate surfaces. Savings made possible by this fact in parts manufacturing costs are described. The long-wearing characteristics of MoS2 coatings allow for extensive ground testing without increasing the risk of failure during erection in orbit. ESA

N90-24502# Marconi Space Systems Ltd., Portsmouth (England).
HEMISPHERICAL POINTING MECHANISM c37
Karl Gallagher *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 273-279 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

The design, development, assembly and testing of a Hemispherical Pointing Mechanism (HPM) are described. The equipment is designed for pointing the Inter Orbital Communications (IOC) antenna on the European Recoverable Carrier (EURECA) spacecraft. The EURECA mission is to include microgravity experiments. The HPM design includes features to reduce microgravity disturbance to the host spacecraft caused by operation of the HPM. The specifications of the mechanism and the results of vibration, environmental, wear and thermal vacuum tests carried out on the mechanism are described. ESA

N90-24503# Sener S.A., Las Arenas (Spain).
COLUMBUS SCIENTIFIC AIRLOCK c18
C. Compostizo and C. Ariza *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 281-288 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

The scientific airlock subsystem developed for the Columbus Attached Pressurized Module (APM) is described. The airlock design is an evolution of the airlock developed by Fokker within the Spacelab program. The Columbus in-orbit long life requirement calls for in orbit maintainability of the airlock. The parts of the airlock which have been completely redesigned are identified. The major modifications have been to the activation of the airlock mechanisms and its electrical control. The maintenance philosophy including in-orbit maintenance is presented. ESA

N90-24504# Sener S.A., Las Arenas (Spain).
A SEQUENTIALLY DEPLOYABLE STRUCTURE FOR SPACE APPLICATIONS. PART 2: ENGINEERING MODEL MANUFACTURING AND TESTING c37
J. Rivacoba, M. Sierra, J. Unda, and M. Eiden (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 289-294 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

The development, manufacture and testing of a deployable Large Truss Structure (LTS) is described. The LTS is designed to meet the requirements for mid-term applications foreseen within the European scenario. A full scale three bay engineering model of the LTS is manufactured and tested. Advantages of the LTS system over other deployable systems are identified. These include automatic sequential deployment with no need for an external power source, very small volume in stowed configuration and good strength and stiffness during deployment. ESA

N90-24505# Centre Suisse de Documentation dans le Domaine de la Microtechnique, Neuchatel.
TRIBOLOGY OF MoS2: EFFECT OF FILM THICKNESS c37
M. Maillat, L. Chollet, H. E. Hintermann, D. Costa, and F. Levy (Ecole Polytechnique Federale de Lausanne, Switzerland) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 295-298 Sponsored by Fondation Suisse pour la Recherche en Microtechnique (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

MoS2 coatings obtained by sputtering are tested on a pin-on-disc friction machine. The thicknesses of the coatings range from 0.032 to 2.3 micrometers. The coatings show a structure and performance dependant on the substrate temperature during deposition. Under particular deposition and test conditions, their sliding life increases proportionally with their thickness. Coatings deposited on heated substrates show lower tribological performances than coatings deposited on cooled substrates. ESA

N90-24506# Polytechnical Univ. of Madrid (Spain). Dept. of Aerospace Materials and Production.
DESIGN AND MANUFACTURING OF AN APTF TO TEST FLUID BEHAVIOUR IN MICROGRAVITY ENVIRONMENT c29
P. Rodriguez, A. Sanz, J. M. Perales, and A. P. Sanz *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 299-304 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

The design and manufacture of an Advanced Plateau Tank Facility (APTF) are described. The APTF is to be used for carrying out Earth experiments, previous to space experiments, on fluid behavior in microgravity environments. The requirements and restrictions to be taken into account in designing and manufacturing an APTF are listed. Mechanisms employed in each part of the prototype are described. Results of parabolic and orbital flights having shown higher gravity levels than predicted, new experiments to correct and update theoretical models are called for. ESA

N90-24507# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
ELECTRICAL CONNECTOR FOR OPERATION IN SPACE c33
Neil Cable and Y. Dohan (Souriau, Paray, France) *In its* Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 305-309 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

The design of electrical connectors able to operate in space vacuum conditions is discussed. These connectors are to be operated by a manipulator arm or by an astronaut during extravehicular activities. The need for such connectors in the Columbus program which incorporates replacement units is stressed. Design guidelines established by ESTEC are presented. Verification of preferred concepts in space simulation tests is described. Test results show that suitable contact design and arrangements can be made. ESA

N90-24508# British Aerospace Public Ltd. Co., Stevenage (England).
INMARSAT OMNI-ANTENNA DEPLOYMENT MECHANISM c37
P. McMahon *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 311-315 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

The Inmarsat omni-antenna deployment mechanism is described. Deployment of the antenna occurs in two stages. Stage one, which occurs while the spacecraft is spinning in transfer orbit, deploys the antenna parallel to the spacecraft Z axis. Stage 2, which occurs on station, moves the antenna radially outward from the spacecraft center line. Both stages are initiated by pyrotechnic release nuts. Novel features, such as the use of roller bearings in the stage one deployment mechanism and the use of a passive low force device to retain the coax cable in position during the launch vibration environment, are discussed. ESA

N90-24509# Oak Ridge National Lab., TN. Energy Div.
THERMODYNAMIC CALCULATIONS FOR MIXTURES OF ENVIRONMENTALLY SAFE REFRIGERANTS USING THE LEE-KESLER-PLOECKER EQUATION OF STATE
Steven K. Fischer and Jim R. Sand 1990 11 p Presented at the International Compressor Engineering Conference, USNC/IIR-Purdue Refrigeration Conference and ASHRAE-Purdue CFC Conference, West Lafayette, IN, 17-20 Jul. 1990
(Contract DE-AC05-84OR-21400)
(DE90-010493; CONF-900742-2) Avail: NTIS HC A03/MF A01

The imminent phaseout of R-11, R-12, and R-115 because of their high ozone depletion potentials has prompted many independent investigations of alternative or substitute refrigerants, either as pure compounds or as mixtures of two or more environmentally acceptable fluids. There are several motivations for investigating mixtures. There are very few pure compounds which can be used for refrigerants that are non-toxic, non-flammable, and also have very low ozone depleting potentials (ODP) and greenhouse warming potentials (GWP). Mixtures composed of three or more components offer a distinct advantage in that careful selection of the components could permit a flammable refrigerant to be used in a blend that remains non-flammable under all conceivable conditions. Also, component concentrations in ternary or higher order mixtures can be adjusted to linearize the temperature-enthalpy profile of a mixture making it more suitable for applications where secondary fluids are heated or cooled through large temperature glides (i.e., refrigeration and air conditioning). The computer model LKPSIM was constructed from subroutines written by Ulf Ploecker and incorporated into a Lorenz cycle refrigerator/freezer simulation model for binary refrigerant mixtures developed at the University of Hannover. Modifications were made to the Hannover routines to compute thermodynamic properties for mixtures of three or more components, the list of available refrigerants was expanded from 11 to 17 possible choices, and a new correlation was developed for computing the interaction coefficients for mixtures of halocarbon refrigerants. Tables of refrigerant molecular weights, critical temperatures and pressures, normal boiling points, acentric factors, and coefficients for fits to the ideal gas heat capacity for each refrigerant are built into a menu-driven data input routine for ease of use. DOE

N90-24293*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
FLIGHT SUPPORT SYSTEM SERVICING AID TOOL
R. Davis *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 73-76 (For primary document see N90-24280 18-12)
Copyright Avail: NTIS HC A19/MF A03; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders CSCL 13I

N90-24294*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
HIERARCHY OF ON-ORBIT SERVICING INTERFACES
Rud V. Moe *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 77-81 (For primary document see N90-24280 18-12)
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32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N90-24510*# Kansas Univ. Center for Research, Inc., Lawrence. Radar Systems and Remote Sensing Lab.
A LABORATORY INVESTIGATION INTO MICROWAVE BACKSCATTERING FROM SEA ICE Ph.D. Thesis
Jonathan W. Bredow Aug. 1989 188 p Sponsored by NASA, Washington, DC
(Contract N00014-89-J-1456)
(NASA-CR-186621; NAS 1.26:186621; AD-A219217; CRINC-RSL-TR-8240-1) Avail: NTIS HC A09/MF A01 CSCL 20/14

The purpose of the research reported here was to determine the sources of scattering of artificial sea ice, to compare backscatter measurements semi-quantitatively with theoretical predictions, and to develop inexpensive polarimetric radars for sea ice backscatter studies. A brief review of the dielectric properties of sea ice and of commonly used surface and volume scattering theories is presented. We provide a description of the backscatter measurements performed and experimental techniques used. The development of inexpensive short-range polarimetric radars is discussed. We discuss limitations of this system and the development of a radar that avoids the oscillator instability problems of continuously tunable oscillators by doing measurements at discrete frequencies, using a synthesized frequency source. We present results of simple test of copolar phase capability and a simple method of doing phase calibrations. We discuss ice surface characterization data and techniques. We also present a method of estimating the standard deviation of rms height and correlation length for cases of few data points. GRA

N90-24511# Naval Postgraduate School, Monterey, CA.
A COMPARISON OF THE K-PULSE AND E-PULSE TECHNIQUES FOR ASPECT INDEPENDENT RADAR TARGET IDENTIFICATION M.S. Thesis
Martin S. Simon Sep. 1989 162 p
(AD-A220172) Avail: NTIS HC A08/MF A01 CSCL 17/9

It has been demonstrated that under laboratory conditions the natural resonant frequencies of a metallic scattering body may be used as the basis for target identification techniques. This thesis continues research into two such techniques: the difference equation based K-Pulse and the integral equation based E-Pulse. A double Gaussian smoothing function has been used in conjunction with the K-Pulse and basis functions of varying widths have been used in formulating the E-Pulse to provide enhanced performance in low signal to noise level environments. Digitally noise polluted synthetic scattered signals are used to analyze the effectiveness of the two techniques in distinguishing high, medium and low-Q targets. Both methods are shown to merit further study as potential candidates for implementation as Resonance Annihilation Filters for real-time radar target identification in a real-world environment. GRA

N90-24512# Naval Ocean Systems Center, San Diego, CA. Ionospheric Branch.
RADAR CLUTTER VIA WAVEGUIDE METHODS Final Report
R. A. Pappert Dec. 1989 44 p Sponsored by Office of Naval

Technology, Arlington, VA
(AD-A220237; NOSC/TD-1739) Avail: NTIS HC A03/MF A01 CSCL 17/9

Recent backscatter results generated by Tappert, using parabolic equation and Monte Carlo methods, afford an excellent opportunity to assess the adequacy of concepts such as shadowing and surface tilting often used in concert with ray concepts for line of sight backscatter calculations. In this study, results of first order scatter from rough surfaces are used in conjunction with waveguide formalism to calculate clutter from distant ranges in tropospheric waveguide environments. Comparisons are made with Tappert's results at 9.6 GHz for the standard atmosphere, and for 14 and 28 m evaporation ducts. Results apply to wind speeds of 10, 20, 30 and 40 knots. Averaged backscattered signals calculated by the two methods, for a transmitter altitude of 25 m, agree to within about + or - 10 dB. This is considered surprisingly good agreement in view of the many uncertainties and approximations involved in the calculations. GRA

N90-24513# Atmospheric and Environmental Research, Inc., Cambridge, MA.
CHARACTERIZING MICROWAVE PROPAGATION USING THE AFGL MICROWAVE ATTENUATION/TRANSMITTANCE/BRIGHTNESS TEMPERATURE CODE Scientific Report No. 1, 1 Jul. 1988 - 30 Jun. 1989
R. G. Isaacs, R. D. Worsham, and B. L. Lindner 1 Aug. 1989 93 p
(Contract F19628-88-C-0120; AF Proj. 6670)
(AD-A220248; GL-TR-89-0188; SR-1) Avail: NTIS HC A05/MF A01 CSCL 20/14

A basic research program is described to investigate weather effects on microwave sensors used to remote sounding and to enhance our knowledge of microwave propagation through clouds and precipitation. In this report, we describe the current RADTRAN algorithm, enumerate its deficiencies, and provide corrective solutions. The latter include: (1) updating the code structure providing user friendly menus and internal comments, (2) providing for consistency with standardized input model atmospheres currently implemented within other Air Force Geophysics Laboratory (AFGL) transmission/radiance models, (3) undertaking a comparison of the current algorithm with contemporary state-of-the-art transmittance/radiance codes to insure its fidelity and representativeness, (4) enhancing RADTRAN to treat multiple scattering, (5) providing calculations of polarized surface emissivities based on user specified surface types, and (6) document the code. Finally, we describe appropriate statistical retrieval schemes for inclusion in the code so that users can perform sensor simulation/retrieval studies. GRA

N90-24514*# Virginia Univ., Charlottesville. Computer Networks Lab.
AIRNET: A REAL-TIME COMUNICATIONS NETWORK FOR AIRCRAFT Final Report
Alfred C. Weaver, Brendan G. Cain, M. Alexander Colvin, and Robert Simoncic Jun. 1990 47 p
(Grant NAG3-630)
(NASA-CR-186140; NAS 1.26:186140; UVA/528238/CS90/101)
Avail: NTIS HC A03/MF A01 CSCL 17B

A real-time local area network was developed for use on aircraft and space vehicles. It uses token ring technology to provide high throughput, low latency, and high reliability. The system was implemented on PCs and PC/ATs operating on PCbus, and on Intel 8086/186/286/386s operating on Multibus. A standard IEEE 802.2 logical link control interface was provided to (optional) upper layer software; this permits the controls designer to utilize standard communications protocols (e.g., ISO, TCP/IP) if time permits, or to utilize a very fast link level protocol directly if speed is critical. Both unacknowledged datagram and reliable virtual circuit services are supported. A station operating an 8 MHz Intel 286 as a host can generate a sustained load of 1.8 megabits per second per station, and a 100-byte message can be delivered from the transmitter's user memory to the receiver's user memory, including all operating system and network overhead, in under 4 milliseconds. Author

N90-24515 British Broadcasting Corp., London (England). Dept. of Research.
HDTV: A CHANCE TO ENHANCE TELEVISION COLORIMETRY
A. Roberts 1990 40 p Original contains color illustrations
(BBC-RD-1990/2) Copyright Avail: Issuing Activity

The development of a new high definition television (HDTV) system for use within Europe has provided a unique opportunity to depart from standard television colorimetry and coding which has been used worldwide since color television began. All television systems in operation at present use coding systems which allow substantial proportions of the perceived luminance to travel via narrow band coloring channels, thus reducing luminance detail in colored areas. This is known as the failure of constant luminance. Also, the gamut of colors reproducible by existing television systems and equipment does not do justice to saturated colors encountered in real life. A new system was devised which greatly expands the color gamut than can be reproduced, and uses constant-luminance coding to avoid loss of detail in colored areas. This has been achieved without compromising compatibility with the existing television system; the proposed system produces signals which can be decoded by a conventional receiver while still producing satisfactory color reproduction and sharpness. The enlarged color gamut of the proposed system will allow future displays to provide continuing improvements in color performance as new types of display (e.g., laser projectors) are developed with increasingly saturated display primaries. The constant-luminance decoding receiver is necessarily more complex than a conventional receiver, and may not be achievable without resort to digital processing in the domestic receiver. Studio monitoring using constant-luminance decoding could also be prohibitive in both cost and complexity. To overcome both of these problems, a modified form of standard decoder has been developed; it almost completely removes the residual color errors due to compatible decoding while retaining the color sharpness advantage of constant-luminance coding. Author

N90-24516# Research Inst. of National Defence, Linkoeping (Sweden). Dept. of Information Technology.
IR AND MILLIMETER WAVES: PROPERTIES, MODELS, AND EXAMPLES OF GROUND TARGET APPLICATIONS
Jan Kjellgren Aug. 1989 51 p In SWEDISH; ENGLISH summary
(FOA-C-30541-3.3; ISSN-0347-3708; ETN-90-96584) Avail: NTIS HC A04/MF A01; Research Inst. of National Defence, Box 1165, S-581 11 Linkoeping, Sweden, 50 Swedish crowns

Literature concerning these objectives was studied. The theory and the background effects are analyzed. Propagation is also addressed. Examples of models of infrared radiometry: PRISM (Physically Reasonable Infrared Signature Model), applied mostly for vehicles; SPACE (Sun, Precipitation, Atmosphere, Clouds, Earth) is used in thermal signatures for military applications. Multispectral image simulation is studied. Concerning multisensors, some applications are reviewed: a counting system for bomber aircraft, and the same for armored cars, based principally on millimeter waves. Some multisensor concepts for propagation problems, such as the identification of remote attack weapons requiring a fitting with three sensors, are given: the laser radar; an infrared sensor for heat data; a sensor of the radiometry in the millimeter wave band. ESA

N90-24517# Research Inst. of National Defence, Linkoeping (Sweden). Dept. of Information Technology.
WAVE PROPAGATION OVER SEA: TROPOSPHERIC EFFECTS ON COMMUNICATION, RADAR, AND ESM SYSTEMS; PROPOSAL FOR A MEASURING PROGRAMME
Boerje Asp Oct. 1989 71 p In SWEDISH; ENGLISH summary
(FOA-C-30544-8.3; ISSN-0347-3708; ETN-90-96586) Avail: NTIS

HC A04/MF A01; Research Inst. of National Defence, Box 1165, S-581 11 Linkoeping, Sweden, 50 Swedish crowns

A measuring technique and the experimental system for transhorizon signal level measurements between Gotland and the Swedish mainland, a distance of about 140 km, are described. A study has shown that the knowledge about anomalous wave propagation over sea, especially the Baltic Sea, is unsatisfactory and has to be improved. The proposed measurements will result in a good statistical description of the wave propagation properties over the Baltic Sea. Original models will be developed using the obtained data and existing prediction models will be tested against the measured data. ESA

N90-24518# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Hochfrequenztechnik.

UTILIZATION OF HIGHER FREQUENCIES FOR SATELLITE COMMUNICATIONS: DETERMINATION OF ATMOSPHERIC EFFECTS USING EXPERIMENTS AND MODELS Ph.D. Thesis - Univ. der Bundeswehr Munich

Arno Schroth Aug. 1989 511 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1211) Original contains color illustrations

(DLR-FB-89-46; ETN-90-96455; ESA-TT-1211) Avail: NTIS HC A22/MF A03; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 180 DM

The basic limitations of future higher frequency (20 to 50 GHz) satellite communications due to propagation effects are discussed. The goals and experiments envisaged with the satellites Olympus and Italsat are presented. Radio frequency channel models are derived and discussed. Techniques for the determination of the atmospheric effects on Earth-satellite radio links are addressed. The instrumentation of the DFVLR radar is described and its performances are demonstrated. ESA

N90-24519# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. HF-Physik.

AN L-BAND ANTENNA ARRAY WITH INTEGRATED PHASE SHIFTERS

Martin Leich Jun. 1989 73 p In GERMAN; ENGLISH summary

(DLR-FB-89-63; ISSN-0171-1342; ETN-90-96487) Avail: NTIS HC A04/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 26 DM

The design and modus operandi of an L-band microstrip antenna array with integrated phase shifter is described. The array consists of phase shift antenna elements. These elements have power capability and can be integrated with two versions of microstrip antennas to form flat conformal arrays. Phase shifters and antenna elements were integrated into a flat conformal array. Different linear arrays were simulated and successfully tested. ESA

N90-24520# Colorado Univ., Boulder.

UNDERSTANDING TROPSCATTER PROPAGATION M.S. Thesis

Joseph Henderson Reynolds 1990 252 p Sponsored by AFIT, Wright-Patterson AFB, OH

(AD-A220969; AFIT/CI/CIA-90-003) Avail: NTIS HC A12/MF A02 CSCL 20/14

Although troposcatter communications systems have shortcomings, this transmission scheme has found consistent use in several applications. Troposcatter propagation is discussed with emphasis on theory, characteristics, and prediction tools. Theoretical understanding of the troposcatter propagation mechanism is rooted in atmospheric phenomena, specifically--refractivity and turbulence. Two modes of transmission exist: incoherent scatter, if refractivity irregularities exist as turbulent blobs, and quasi-coherent scatter, if irregularities arrange themselves in layers. Frequency and meteorological parameters define the dominant mechanism. One can expect received signal levels to exhibit distance and frequency dependence; short and long-term fading; aperture-to-medium coupling loss; and diurnal, seasonal, climatic, and meteorological variations. Diversity techniques are indispensable in thwarting short-term fading. Atmospheric multipath is known to limit analog system bandwidths yet digital systems are prone to the related delay spread phenomenon which causes intersymbol interference. Adaptive processing is used to overcome this problem and can further improve digital performance through implicit diversity. Most troposcatter prediction methods are rooted in empirical expressions. Unfortunately, all the methods suffer shortcomings with reliance on surface refractivity and incorrect coupling loss calculations topping the list. GRA

N90-24521# Harry Diamond Labs., Adelphi, MD.

DOWN-RANGE IMAGING OF RADAR TARGETS Final Report, 1986 - 1988

Joseph D. Silverstein Jan. 1990 50 p Sponsored by Army Lab. Command, Adelphi, MD

(AD-A221084; HDL-TR-2166) Avail: NTIS HC A03/MF A01 CSCL 17/9

A derivation is given of the one-dimensional, down-range image of a radar target in terms of the discrete Fourier transform (DFT) of the target returns at each of a number of equally spaced radar frequencies. The formula for the image is applied to return signals computed for point targets. In general, as long as the points are separated by at least 1.5 resolution cell widths, and their reflectivities differ by no more than a factor of 2, the images yield fairly accurate information on both the relative location and reflectivity of the points of the target. GRA

N90-24522# Army Engineer Topographic Labs., Fort Belvoir, VA.

AUTOMATED SEGMENTATION AND EXTRACTION OF AREA TERRAIN FEATURES FROM RADAR IMAGERY Report, Apr. 1987 - Mar. 1989

Pi-Fuay Chen and Richard A. Hevenor Jan. 1990 27 p

(AF Proj. 4A1-61102-B-523)

(AD-A221096; ETL-0554) Avail: NTIS HC A03/MF A01 CSCL 08/2

An automated method for segmenting and extracting certain area terrain features from Synthetic Aperture Radar (SAR) imagery is presented. First, the input radar image is edge-enhanced by passing it through a Sobel operator in order to obtain the required edges for further processing. The unwanted noise, both from the original image source and from the edge operation, is reduced with a low-pass filter. The next step is a region growing process in which pixels of similar gray values in the filtered image are grouped and merged together. A method of selecting an optimum threshold that is essential for region growing is described. The pixels in the image after the region growing operation are further grouped into exactly four different categories, each with its own gray value. The four categories of pixels are finally classified as water, fields, forests, or urban areas depending upon their gray values. A texture measurement scheme and a Bayes classifier are also incorporated into this effort for verifying the classification results. GRA

N90-24523# Massachusetts Inst. of Tech., Cambridge. Lincoln Lab.

SIGNAL PROCESSING ON FINITE GROUPS

Richard B. Holmes 27 Feb. 1990 14 p

(Contract F19628-90-C-0002)

(AD-A221129; TR-873; ESD-TR-89-267) Avail: NTIS HC A03/MF A01 CSCL 09/1

A unified approach to the design and evaluation of fast algorithms for discrete signal processing is developed. Based on the theory of finite groups, it hence includes the familiar cases of the fast Fourier and Walsh-Hadamard transforms. However, the use of noncommutative groups reveals a large variety of novel methods. Some of these exhibit a superior performance, as measured by both reduced error rates and computational complexity, on nonstationary data. The recent history of this subject is reviewed first, followed by a detailed examination of the three principal ingredients of the present study: the underlying groups, the signal-processing tasks on which the group-based algorithms

are to compete, and the signal models used to define the data environment. Test results and conclusions then follow, the former being based on the use of random correlation matrices. GRA

N90-24524# Coast Guard Research and Development Center, Groton, CT.
SWEEP WIDTH DETERMINATION FOR HU-25B AIRBORNE RADARS: LIFE RAFT AND RECREATIONAL BOAT TARGETS Final Report, May 1987 - May 1989
M. J. Lewandowski, R. Q. Robe, A. A. Allen, W. H. Reynolds, G. L. Hover, S. A. Exley, H. S. Searle, and P. V. Clark (Analysis and Technology, Inc., New London, CT.) Sep. 1989 143 p
(Contract DTCG39-87-C-80497)
(AD-A221362; USCG-D-01-90) Avail: NTIS HC A07/MF A01 CSCL 17/9

During October and December 1988 the U.S. Coast Guard R and D Center conducted two experiments to determine sweep widths for airborne radar search by Coast Guard HU-25B aircraft. Search objects were 4- to 10-person life rafts and 23- to 42-foot recreational-type boats. Two radar systems were evaluated: the AN/APS-127 forward-looking airborne radar (FLAR) and the AN/APS-131 side-looking airborne radar (SLAR). Realistic radar searches were conducted in Block Island Sound off the CT/RI/NY coast and in the Atlantic Ocean off Nova Scotia, Canada, to collect data using unalerted sensor operators and standard search patterns. Aircraft and target positions were recorded by a precision microwave tracking system. Target detections and environmental conditions were recorded by observers onboard the search aircraft and the target vessels. Sea conditions represented in the data analysis included 0- to 4-foot significant wave heights and 0- to 28-knot winds. Data from the 1988 experiments were combined with data collected during 1987 where appropriate. Analysis of the data confirmed that sweep widths varied with significant wave height and target size. Recommended sweep width values and HU-25 electronic search guidance are presented, along with a recommendation for computer simulation to develop POD versus coverage factor curves for HU-25 electronic search planning. GRA

N90-24525# Technische Univ., Berlin (Germany, F.R.). Fachbereich Physik.
NEAR FIELD CURVATURE AT PARALLEL PHASE OBJECTS: MODEL EXAMINATION WITH MICROWAVES Ph.D. Thesis [NAHFELDBEUGUNG AN DOPPELSTREIFEN-PHASENOBJEKTEN: MODELLUNTERSUCHUNGEN MIT MIKROWELLEN]
Manuel Fraatz 1989 131 p In GERMAN
(ETN-90-96499) Avail: NTIS HC A07/MF A01

The variations of the near field curvature are experimentally and theoretically examined at phase structures. In the approximation of the geometrical optics, a plane incident wave is outphased of 90 degrees by passage through a lamella phase object. This phase distribution gives a structurally good representation for the borderline case of thin and weak phase objects. The near field behind the objects is relatively starkly influenced by the curvature interference effects and was exactly recorded with a special microwave double-ray interferometer. From the half-value width of both mean maxima of the phase distribution the band width and distance can be easily deduced. A simple digital process is developed from the Kirchkoff curvature theory to describe the measured near field distribution. ESA

N90-24526# Technische Univ., Berlin (Germany, F.R.). Fachbereich Elektrotechnik.
FILTER PROCESS FOR PARASITIC SUPPRESSION FOR RECEPTION OF SPECTRALLY SEPARATED EMISSION SIGNALS Ph.D. Thesis [FILTERVERFAHREN ZUR STOERUNTERDRUECKUNG FUER DEN EMPFANG SPEKTRAL GESPREIZTER SENDESIGNALE]
Ralph Urbansky 1989 153 p In GERMAN
(ETN-90-96506) Avail: NTIS HC A08/MF A01

Data transmission by disrupted channels is studied, particulary in the case of the electrical supply network used as transmission channel for network control and charge management systems for increasing the availability and a better primary energy utilization. Direct sequence systems working with filters are presented, which improve the receiving properties without maximizing the signal noise ratio as regards the reception and by minimizing the bit error rates for normaly distributed parasitics. The optimal algorithm for maximizing the signal to noise ratio is described in time discrete form as a transformation of the vectorial receiving signal with the inverse covariance matrix of the parasitics. ESA

N90-24527# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. of Communications.
DEVELOPMENT OF A SIX PORT NETWORK ANALYSIS TOOL FOR THE 1 TO 18 GHz BANDWIDTH RANGE Thesis [REALISATION D'UN ANALYSEUR DE RESEAUX SIX PORTES DANS LA BANDE DE FREQUENCE 1 TO 18 GHZ]
Eric Bergeault Oct. 1989 93 p In FRENCH
(Telecom-Paris-89-D-015; ISSN-0751-1345; ETN-90-96958)
Avail: NTIS HC A05/MF A01

A double six door analysis tool allowing for vectorial determination of the dispersion parameters of quadri-pole hyperfrequencies based on power measurements is presented. The design of the reflectometers is simpler than those used in heterodyne systems. They do not call for frequency transposition or modulation, but work directly from the high frequency source. Power detectors are the only receptors needed. Automatic control of the system is very simple. The power detectors use Schottky diodes. The response of these detectors can be linearized in situ. Results obtained are precise to at least a thousandth of a decibel. ESA

N90-24528*# Honeywell, Inc., Bloomington, MN. Sensors and Signal Processing Lab.
THE 30-GHz MONOLITHIC RECEIVE MODULE Interim Report, 1 Nov. 1985 - 31 Oct. 1987
P. Bauhahn, J. Geddes, V. Sokolov, and T. Contolatis Apr. 1988 150 p
(Contract NAS3-23356)
(NASA-CR-180849; NAS 1.26:180849) Avail: NTIS HC A07/MF A01 CSCL 17B

The fourth year progress is described on a program to develop a 27.5 to 30 GHz GaAs monolithic receive module for spaceborne-communication antenna feed array applications, and to deliver submodules for experimental evaluation. Program goals include an overall receive module noise figure of 5 dB, a 30 dB RF to IF gain with six levels of intermediate gain control, a five bit phase shifter, and a maximum power consumption of 250 mW. Submicron gate length single and dual gate FETs are described and applied in the development of monolithic gain control amplifiers and low noise amplifiers. A two-stage monolithic gain control amplifier based on ion implanted dual gate MESFETs was designed and fabricated. The gain control amplifier has a gain of 12 dB at 29 GHz with a gain control range of over 13 dB. A two-stage monolithic low noise amplifier based on ion implanted MESFETs which provides 7 dB gain with 6.2 dB noise figure at 29 GHz was also developed. An interconnected receive module containing LNA, gain control, and phase shifter submodules was built using the LNA and gain control ICs as well as a monolithic phase shifter developed previously under this program. The design, fabrication, and evaluation of this interconnected receiver is presented. Progress in the development of an RF/IF submodule containing a unique ion implanted diode mixer diode and a broadband balanced mixer monolithic IC with on-chip IF amplifier and the initial design of circuits for the RF portion of a two submodule receiver are also discussed. Author

N90-24988*# Stevens Inst. of Tech., Hoboken, NJ. Dept. of Electrical Engineering and Computer Science.
SOME ISSUES RELATED TO SIMULATION OF THE TRACKING AND COMMUNICATIONS COMPUTER NETWORK Final Report
Robert C. Lacovara *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 11 p

(For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 17B

N90-25037*# Hampton Univ., VA. Airway Science Program.
AUTOMATIC SPEECH RECOGNITION IN AIR-GROUND DATA LINK Abstract Only
Herbert B. Armstrong *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 46-47 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 17B

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N90-24529# Institute of Electrical and Electronics Engineers, Piscataway, NJ. Lasers and Electro-Optics Society.
WORKSHOP ON III-V INTEGRATED OPTOELECTRONICS Final Report, 20 Mar. 1989 - 19 Mar. 1990
Robert T. Wangemann Jan. 1990 79 p Workshop held in Hilton Head, SC, 28-30 Mar. 1989
(Contract MIPR-133-89)
(AD-A218759; ARO-26846.1-PH-CF) Avail: NTIS HC A05/MF A01 CSCL 09/5

A workshop was held for the purpose of bringing together researchers with a broad range of interests in Opto Electronic Integrated Circuits (OEIC) and related technologies. The objective was to review the current status and future prospects for OEIC devices, as well as related materials and materials processing technologies. The discussions that took place and some of the conclusions drawn are reported. Areas covered include: emerging systems requirements, materials growth and processing for OEICs, state-of-the-art discrete components, a review of the current status of OEIC research devices, and a discussion of the conclusions of the workshop. GRA

N90-24530# Argonne National Lab., IL. Electrochemical Technology Program.
CURRENT DISTRIBUTION IN CYLINDRICAL POROUS ELECTRODES
Simon L. Marshall 1990 24 p Presented at the Spring Meeting of the Electrochemical Society, Montreal, Canada, 6-11 May 1990
(Contract W-31-109-eng-38)
(DE90-009707; CONF-900562-4) Avail: NTIS HC A03/MF A01

A general solution of the equations defining the potential distribution in porous electrodes is derived. Finite conductivity of the metallic matrix is considered. The results are used to determine axially symmetric potential and current distributions in cylindrical porous electrodes in cases where current flow is radial. Values of the matrix:electrolyte conductivity ratio for which the limiting case of an infinitely conductive matrix is closely approached are determined. A formula for the area-specific resistance is given, and a procedure for optimizing electrode thickness with respect to transfer current uniformity is described. Deviations from one-dimensional current distribution that result from specification of nonuniform current density at the boundary are considered. DOE

N90-24531# Eveready Battery Co., Inc., Westlake, OH. Technology Lab.
NEW LIQUID CATHODE ELECTROLYTES IN HIGH RATE CELLS Interim Technical Report
Jean W. Bailey, David W. Kalisz, and George E. Blomgren 15 Mar. 1990 29 p Submitted for publication
(Contract N00014-86-C-0808)
(AD-A219822; TR-1) Avail: NTIS HC A03/MF A01 CSCL 09/1

The power limitations of liquid oxyhalide batteries were explored by examining the physical and electrical properties of new electrolytes. Conductivity, kinematic viscosity, and specific gravity of electrolytes were measured inside a specially adapted argon filled drybox. Liquid cathode oxyhalide electrolytes designed to enhance power density were tested first in demountable test cells and then, the most promising, in hermetically sealed high rate F size jellyroll cells. For F cells, the capacity on constant current discharge was measured at 3.5 and 12.5 mA/sq cm for fresh cells at 21 C and at 3.5 mA/sq cm for cells stored 4 weeks at 54 C then discharged at -30 C. An optimized cell design with thicker electrodes was developed for testing electrolytes with higher conductivity than LiAlCl4-SOCl2. The best capacity at 2A was achieved with LiGaCl4-SOCl2 or LiAlCl4-SOCl2. The best capacity at 7A was achieved with LiGaCl4-SOCl2. LiGaCl4 in SOCl2 was found to discharge at higher temperatures than LiAlCl4 in SOCl2. Imidazolium, aralkylammonium, and sulfonium chlorides were found to have high solubility and conductivity in thionyl chloride, but lithium was found to be passive in contact with these solutions and most metals corroded excessively. These salts mixed with aluminum chloride were much less aggressive and when mixed with lithium salts in addition gave high conductivity and test cell capacities. GRA

N90-24532# Eveready Battery Co., Inc., Westlake, OH. Technology Lab.
THE EFFECT OF CARBON TYPE AND PROCESSING ON HIGH RATE THIONYL CHLORIDE CATHODE COLLECTORS Interim Technical Report
John C. Bailey, David W. Kalisz, and George E. Blomgren 20 Mar. 1990 35 p Submitted for publication
(Contract N00014-86-C-0808)
(AD-A219823; TR-2) Avail: NTIS HC A03/MF A01 CSCL 10/3

This study was initiated to determine the effects of carbon type, treatment and additives and the manufacturing process on high rate performance of thionyl chloride cathode collectors. Seventeen different collector materials and treatments were tested in demountable test cells and the results compared on the basis of capacity and energy per unit void volume of the cathode collector. Superior results were consistently obtained from CoTMPP catalyzed carbons and from carbon microfibers. Better voltage results were obtained from Ketjenblack EC, but the capacity was not consistently better than acetylene black. Process conditions did not show strong correlations, but in some cases there appears to be a best process for a given carbon type. A significant high rate (7 A test) capacity improvement was seen in F cells with a carbon fiber electrode in agreement with test cell results. Other test cell results did not correlate well with F cell tests, but further work is required to establish statistical significance. GRA

N90-24533# Texas Univ., Austin. Microwave Lab.
MONOLITHIC PHASE SHIFTER STUDY Final Technical Report, Nov. 1985 - Oct. 1988
D. P. Neikirk and T. Itoh 15 Feb. 1990 55 p
(Grant AF-AFOSR-0036-86; AF Proj. 2305)
(AD-A219859; MW-90-P-1; AFOSR-90-0343TR) Avail: NTIS HC A04/MF A01 CSCL 09/1

Modeling and testing of monolithic coplanar waveguide (CPW) phase shifters using both optical and Schottky-contact control techniques have been performed. Simulation work on a periodically illuminated structure has been completed, showing that some improvement in performance may be possible, although with a reduction in frequency bandwidth. CPW transmission lines have been fabricated on semi-insulating GaAs, on lightly and heavily doped epi GaAs, and on AlGaAs/GaAs heterostructure, and electrical characterization has been performed. Both Schottky-bias controlled mechanism, using constant D.C. bias while using optical control has also been developed, which has yielded the best

experimental performance to date for a distributed CPW phase shifter. GRA

N90-24534# Air Force Occupational Measurement Center, Randolph AFB, TX.
ELECTRONICS PRINCIPLES INVENTORY, SHEPPARD TECHNICAL TRAINING CENTER
Feb. 1990 172 p
(AD-A219935; AFPT-90-EPI-825) Avail: NTIS HC A08/MF A01 CSCL 05/9

Data are provided on the electronic principles (EP) used by airmen in 13 Air Force Specialties (AFSs) with initial training at Sheppard Technical Training Center (TTC). The USAF Electronic Principles Inventory (AFPT 90-EPI-825) was administered to random samples of fully qualified job incumbents representing the 13 AFSs in this report. The data were collected from March 1987 to September 1988. Although there is no specific regulatory guidance on the use of EPO data, the survey data lends itself to the use of cutoff scores for deciding which EPI items to include in centralized training for each AFSC. Once the training needs of the individual AFSCs have been determined, the possibility for consolidated EP training can be considered. GRA

N90-24535# Stanford Univ., CA. Physics Lab.
DEVELOPMENT OF AN ALL SILICON INTEGRATED OPTICAL MODULATOR FOR HIGH SPEED DATA COMMUNICATIONS AND SENSOR APPLICATIONS Final Report, Aug. 1988 - Nov. 1990
O. Solgaard, J. I. Thackara, A. A. Godil, B. R. Hemenway, and D. M. Bloom 31 Jan. 1990 32 p
(Contract DAAL03-88-K-0120)
(AD-A220270; ARO-26088.3-PH) Avail: NTIS HC A03/MF A01 CSCL 09/5

The first generation silicon light intensity modulator had a modulation depth of up to 30 percent in a bandwidth up to 200 MHz in accordance with the intents of the project, the modulator occupied a small surface area and is fabricated using standard silicon technology, making the modulator suitable for integration with silicon integrated circuits. The second generation of the modulator had several refinements, among which the push-pull design proved to be the most worth while, giving a doubling of the modulation depth. In the design of the modulator special emphasis was put on easy interfacing with fiber optics, and it was demonstrated that the modulator could not only simply and inexpensively be directly coupled to single mode optical fibers (pigtailing), but that the direct coupling of the modulators was more effective and led to a higher modulation index (24 percent) and lower insertion loss (5 dB) even without a anti reflection coating. During the course of the project related areas of interest in device research has been discovered. Among these, electro-optic polymers for high speed modulators and integrated circuit probes have received the most attention so far. A new guest/host system of purely commercially available chemicals had been developed and basic material characteristics in the 1 to 100 GHz are being measured. GRA

N90-24536# Georgia Inst. of Tech., Atlanta. gw167534
CONCEPT STUDY FOR UHF T/R MODULES Final Technical Report, Nov. 1988 - Sep. 1989
David W. Hughes Feb. 1990 136 p
(Contract F30602-88-D-0025; AF Proj. 4506)
(AD-A220281; RADC-TR-89-361) Avail: NTIS HC A07/MF A01 CSCL 09/1

This report discusses some important issues related to the performance and producibility of ultrahigh frequency (UHF) transmit/receive modules. Unfortunately, there are a number of factors which currently limit precision phase and gain tracking between such modules. Some of this variability results from imperfections in the modules themselves while other contributors are a consequence of the very nature of the array environment. An analysis of these issues, with a concomitant identification of the major gaps in the knowledge base of underlying technologies, permits the development of an investment strategy for UHF. Some pillars of this strategy involve the use of transistors at lower frequencies, a re-visiting of balanced circuitry, the development of both improved power devices and methods to power combine such devices, an optimization in the level of integration and the incorporation of post-assembly tweaking techniques for module manufacturing. Augmenting these activities with enhancements in both open-loop and closed-loop module control help permit the deployment of phased array radars with performance envelopes will beyond the current state-of-the-art. GRA

N90-24537# Texas Univ., Austin. Microwave Lab.
ANALYSIS AND APPLICATIONS OF THE CROSSTIE-OVERLAY SLOW-WAVE STRUCTURE
Yu-De Lin and Tatsuo Itoh Feb. 1990 82 p
(Contract DAAL03-88-K-0005)
(AD-A220286; MW-90-P-2; ARO-25045.35-EL) Avail: NTIS HC A05/MF A01 CSCL 09/1

The crosstie-overlay slow-wave structure is proposed as a passive circuit element in monolithic microwave integrated circuits. The propagation characteristics of the crosstie-overlay slow-wave structure are analyzed both analytically and experimentally. In analysis, a method suitable for design as well as a rigorous two-dimensional spectral domain method for accurate results are developed. The results obtained in analysis are checked with experimental results. They are in good agreement. A modified structure is proposed to reduce the conductor loss. Distributed Chebychev bandstop filters utilizing the slow-wave structure are designed. Another circuit application of the slow-wave structure, frequency scanning antenna, is also investigated. GRA

N90-24538# New Mexico Univ., Albuquerque. Dept. of Physics.
HETERODYNE CHARACTERIZATION OF HIGH-SPEED PHOTOMIXERS FOR THE ULTRAVIOLET Ph.D. Thesis
Billy Wayne Mullins 1990 214 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A220914; AD-E501211; AFIT/CI/CIA-90-008D) Avail: NTIS HC A10/MF A02 CSCL 09/1

A detailed experimental and theoretical investigation of high speed photodiodes is presented. Detector geometries included both planar and interdigitated designs with gap widths of 1.0, 3.0 and 4.5 microns. Detailed photomixing measurements were performed using a ultraviolet heterodyne system operating at 334.5 nm. Measurements included frequency response to 10 GHz as a function of beam position, bias and optical power. Limited measurements were made to 18 GHz. A detailed, first principles, model of msm-photodiode frequency response including carrier drift velocity, diffusion, recombination and beam position is derived. Including packaging effects, good agreement was found between the experimental results and the model. GRA

N90-24539# Stanford Univ., CA. Dept. of Chemistry.
STUDIES OF CHEMISTRY AND DIFFUSION ON SILICON AND GALLIUM ARSENIDE SURFACES USING LASER-INDUCED THERMAL DESORPTION Final Technical Report
Steven M. George 1990 26 p
(Contract N00014-86-K-0545)
(AD-A220946) Avail: NTIS HC A03/MF A01 CSCL 09/1

Surface chemistry and surface diffusion play pivotal roles in semiconductor processing and must be understood as electronic device dimensions approach the submicron level. In this project, basic time-dependent processes on silicon surfaces were examined using laser induced thermal desorption (LITD) and Fourier transform infrared (FTIR) spectroscopy. These techniques provided direct, quantitative measurements of surface coverage in real-time. Using LITD and FTIR techniques, emphasis was on a microscopic understanding of semiconductor surface reaction kinetics. GRA

N90-24540# Bell Telephone Labs., Inc., Reading, PA.
GALLIUM ARSENIDE PILOT LINE FOR HIGH PERFORMANCE COMPONENTS Semiannual Technical Report, Apr. - Sep. 1989
16 Jan. 1990 59 p
(Contract F29601-87-C-0202)
(AD-A220948) Avail: NTIS HC A04/MF A01 CSCL 09/1

The Gallium Arsenide Pilot Line for High Performance Components (Pilot Line III) is to develop a facility for the fabrication of GaAs logic and memory chips. The first thirty months of this contract are now complete, and this report covers the period from March 27 through September 24, 1989. Similar to the PT-2M SRAM function for memories, the six logic circuits of PT-2L and PT-2M have served their functions as stepping stones toward the custom, standard cell, and cell array logic circuits. All but one of these circuits was right first time; the remaining circuit had a layout error due to a bug in the design rule checker that has since been fixed. The working devices all function over the full temperature range from -55 to 125 C. They all comfortably meet the 200 MHz requirement. They do not solidly conform to the required input and output voltage levels, particularly Vih. It is known that these circuits were designed with the older design models and that they came from an era where the DFET thresholds were often not on target. GRA

N90-24541# Texas Instruments, Inc., Dallas.
EHF HETEROJUNCTION BIPOLAR TRANSISTORS Interim Technical Report No. 1, 1 Nov. 1988 - 31 Dec. 1989
Burhan Bayraktaroglu and T. Henderson 15 Jan. 1990 21 p
(Contract N00014-88-C-0613)
(AD-A220984; TI-08-90-01-0613INT) Avail: NTIS HC A03/MF A01 CSCL 09/1

The purpose of this work is to determine if strained layers can be used to enhance performance for GaAs-based HBTs (Tasks 4 and 5), the use of InGaAs layers was investigated in the base and emitter cap layer. The purpose is to aid in formation of ohmic contacts and, in the case of InGaAs in the base region, also to serve as an etch stop. The performance of this device is comparable to that of a GaAs/AlGaAs control device with no InGaAs layers, so it was concluded that the use of InGaAs contact layers does not significantly improve performance. However, the use of an InGaAs etch-stop layer in the base greatly simplifies device processing, which will enable the use of thinner base regions with reduced transit times and, therefore, will improve device frequency response. GRA

N90-24542# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
IN-SITU TOPOGRAPHICAL IMAGING OF ELECTRODE SURFACES USING HIGH RESOLUTION PHASE-MEASUREMENT INTERFEROMETRIC MICROSCOPY Technical Report, 10 Apr. 1989 - 10 Apr. 1990
Henry S. White, David J. Earl, John D. Norton, and Harlan J. Kragt 10 Apr. 1990 27 p Submitted for publication
(Contracts N00014-87-K-0494; DE-FG02-88ER-45338; NSF CBT-88-07676)
(AD-A221021; TR-8) Avail: NTIS HC A03/MF A01 CSCL 09/1

Three-dimensional topographical imaging of electrode surfaces using phase-measurement interferometric microscopy is described. Topographical measurements are based on a rapid, non-destructive optical method that provides ultrahigh vertical resolution (0.6 nm) and moderate horizontal resolution (0.5 microns). In-situ images of electrodes prepared from highly oriented pyrolytic graphite, platinum thin films, and polycrystalline iron are reported. In-situ measurement of the time-dependent growth of corrosion pits on FE in 0.1 M H2S04 is also demonstrated. GRA

N90-24543# Syracuse Univ., NY.
FAILURE MECHANISMS OF GaAs TRANSISTORS: A LITERATURE SURVEY Final Technical Report, Aug. 1987 - Sep. 1988
Snorre Prytz Mar. 1990 64 p
(Contract F30602-81-C-0169; AF Proj. 2306)
(AD-A221089; RADC-TR-90-23) Avail: NTIS HC A04/MF A01 CSCL 09/1

This report is a summary of information from a literature survey of GaAs component failure modes. A brief outlook on GaAs material and techniques used in fabrication of GaAs devices is included. Failure modes common to GaAs metal semiconductor field effect transistors (MESFET's) are discussed excluding modes common to Si components such as metal migration and intermetallic formation. As the same failure modes seen in discrete MESFET's will occur in monolithic microwave integrated circuits (MMIC) and digital GaAs devices, the discussion does not include these devices per se. Side-gating or backgating problems seem to be material or design related and therefore are not treated as failure modes. Besides the interaction of metal and GaAs in ohmic contact areas, the importance of the quality of the GaAs surface in the reliability of GaAs components is discussed. Also discussed is the relation of free As on the surface to both long and short term failure modes. GRA

N90-24544# Naval Research Lab., Washington, DC. Beam Physics Branch.
MILLIMETER-WAVE GYROKLYSTRON AMPLIFIER EXPERIMENT USING A RELATIVISTIC ELECTRON BEAM Memorandum Report, Sep. 1988 - Mar. 1990
S. H. Gold, A. W. Fliflet, W. M. Manheimer, D. A. Kirkpatrick, W. M. Black, A. K. Kinkead, D. L. Hardesty, and M. Sucy (JAYCOR, Vienna, VA.) 8 Mar. 1990 32 p
(AD-A221209; NRL-MR-6625) Avail: NTIS HC A03/MF A01 CSCL 09/1

A fundamental mode TE(0) sub 111 two-cavity intense-beam gyroklystron amplifier experiment, operating at an accelerating voltage of 1 MV, has demonstrated a linear gain of 19 dB and an unsaturated power of 100 kW. The frequency of the second cavity has been found to track the frequency of the driven cavity over a range of 300 MHz around a center frequency of 35 GHz. Stable amplifier operation was achieved with beam currents as large as 150 A and a velocity pitch ratio of 0.36. The stable operating range was limited by spurious oscillation in the TE(0) sub 112 mode. Theoretical calculations indicate that higher gains might be attainable if this mode could be suppressed. The two cavities which were tested are intended to serve as bunching cavities for a high power output cavity to be tested at a later date. GRA

N90-24545# Wisconsin Univ., Madison. Dept. of Electrical and Computer Engineering.
THE PROBLEM OF ROBUST COMPENSATION FOR SYSTEMS WITH UNMODELED DYNAMICS Final Report, 1 Jan. 1988 - 31 Dec. 1989
J. Daniel Cobb 31 Dec. 1989 92 p
(Grant AF-AFOSR-0087-88; AF Proj. 2304)
(AD-A221246; AFOSR-90-0388TR) Avail: NTIS HC A05/MF A01 CSCL 09/1

The goal has been to explore the problem of designing feedback control systems that are insensitive to the presence of high-frequency dynamics not accounted for explicitly in the mathematical model of the plant. Some of the previous work suggests that it is possible to design controllers which simultaneously stabilize a given nominal system as well as a large class of small singular perturbations of the system. Attached are six papers summarizing work which has been supported all or in part by the present grant. GRA

N90-24546# Rome Air Development Center, Griffiss AFB, NY.
PERSONAL COMPUTER (PC) THERMAL ANALYZER
James M. Vaccaro, Douglas J. Holzhauer, and Paul S. Yaworsky Mar. 1990 48 p
(AF Proj. 2338)
(AD-A221325; RADC-TR-90-64) Avail: NTIS HC A03/MF A01 CSCL 12/6

Rome Air Development Center (RADC) has developed an expert system based design verification tool to increase the efficiency of calculating device junction temperatures on printed circuit boards (PCBs). This tool, the Personal Computer (PC) Thermal Analyzer, was developed for reliability and electronic design engineers for use during the computer-aided design (CAD) phase. The PC Thermal Analyzer was developed through the combination of two technical areas, thermal analysis and expert systems. This intelligent analyzer is a more effective verification tool because traditional tools require much time and knowledge of thermal

analysis, while the PC Thermal Analyzer is quick, requires no expertise in thermal analysis, and provides useful results during the CAD phase. GRA

N90-24547# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ. Product Assurance Directorate.
THE FEASIBILITY OF DETECTING CORROSION IN ELECTRIC FUZES USING THE THERMAL TRANSIENT TECHNIQUE Final Report, Sep. 1989 - Jan. 1990
Andre Shankle and Robert Maiello Apr. 1990 73 p
(AD-A221385; ARPAD-TR-90001) Avail: NTIS HC A04/MF A01 CSCL 19/1

The object of this experiment was to determine if the thermal transient test can be used to detect corrosion on the bridgewire in an electric fuze or electroexplosive device (EED). The fuzes are used to set self-destruct times in the following mines: M74, M75, BLU-92/B. When the mines are exposed to high humidity the bridgewire inside the fuze is susceptible to corrosion. An open (corroded) fuze may initiate the wrong self-destruct time which in turn will create a hazardous condition for friendly troops. Two examples of severe corrosion of the bridgewire in a fuze are shown. These photographs were taken by a scanning electron microscope. The current method for detecting corrosion in a fuze is measuring the cold resistance of the bridgewire. A high resistance reading indicates evidence of corrosion. It will be determined if the thermal transient test can be used as an alternative method. The thermal transient test is a nondestructive examination technique for inspection of the critical bridgewire interface. The test allows one to see inside the fuze non-destructively and determine if certain failure conditions or abnormalities are present. GRA

N90-24548# Technische Univ., Berlin (Germany, F.R.). Fachbereich Elektrotechnik.
CONTROLING, CABLING AND PROTECTION OF GTO THYRISTORS IN PULSE INVERTERS Ph.D. Thesis [ANSTEUERUNG, BESCHALTUNG UND SCHUTZ VON GTO-THYRISTOREN IN PULSWECHSELRICHTERN]
Matthias Jung 12 Dec. 1989 140 p In GERMAN
(ETN-90-96500) Avail: NTIS HC A07/MF A01

A simple correlation was derived for the estimation of the reachable power of a converter. The maximum power of a three phase inventer in B-assembly is around a quarter of the fictitious rupture power of a GTO (Gate Turn-Off) thyristor. The active power needed was evaluated for the case of a high power. The cascade assembly was studied as a particular case and found to be especially suitable for low powers. By means of typical data it was shown that for similar switching frequency the switch losses of a GTO increase with the inverter power and can become the most important part of the losses. Measurements at GTO thyristors were compared with the results of a static induction thyristor, whose properties are similar but which switches twice as fast and needs a lower charge capacity. ESA

N90-24549# Technische Univ., Berlin (Germany, F.R.). Fachbereich Elektrotechnik.
A CAPACITANCE PROCESS FOR CONTACT-FREE MICROFILE MEASUREMENT ON METALLIC SURFACES Ph.D. Thesis [EIN KAPAZITIVES VERFAHREN ZUR BERUEHRUNGSFREIEN MIKROPROFILMESSUNG AN METALLISCHEN OBERFLAECHEN]
Andreas Kegler 1989 170 p In GERMAN
(ETN-90-96503) Avail: NTIS HC A08/MF A01

The electric field between the capacitive sensor and the electrically conducting component surface is examined. The measuring electrode of the capacitance sensor is surrounded by a potentially supplied screen electrode, which allows a focusing of the electric field, that improves the sensitivity of the effective measuring capacity. A digitally produced alternating voltage source is used as an electric compensating circuit because of its high measuring sensitivity and its very small measuring errors. The capacitance sensor is integrated in this circuit and is composed of a frequency depending voltage divider with an ohmic reference resistance. ESA

N90-24550# Sandia National Labs., Albuquerque, NM.
A NEW TECHNIQUE FOR HARDENING OPTICALLY-TRIGGERED THYRISTORS
R. F. Carson, R. C. Hughes, H. T. Weaver, T. M. Brennan, and B. E. Hammons 1990 5 p Presented at the 27th IEEE Annual International Nuclear and Space Radiation Effects Conference, Reno, NV, 16-20 Jul. 1990
(Contract DE-AC04-76DP-00789)
(DE90-006769; SAND-90-0226C; CONF-900723-1) Avail: NTIS HC A01/MF A01

Optically triggered thyristors are hardened to high x ray dose rates by the addition of a monolithically integrated compensating photodetector. Tests of discrete device arrangements show radiation induced switching is completely inhibited up to 1.4 x 10(exp 9) rad (Si)/sec. DOE

N90-24551# Lawrence Livermore National Lab., CA.
PREDICTION OF HIGH-VOLTAGE, BROADBAND RF PULSE GENERATION FROM AN AIR GAS AVALANCHE SWITCH
D. J. Mayhall and J. H. Yee Mar. 1990 21 p
(Contract W-7405-eng-48)
(DE90-010183; UCRL-ID-103335) Avail: NTIS HC A03/MF A01

The generation of high voltage, broadband RF pulses will make possible very important advances in radar technology. Recent 2-D computer code calculations on a simple air gas avalanche switch geometry predict the generation of unipolar electromagnetic pulses at voltages from 227 kV to 3.90 MV and bandwidths of about 24 GHz. Computational pulse tail chopping increases the bandwidths to 31 to 44 GHz. The gas avalanche switch consists of a set of pulse-charge high voltage electrodes immersed in gas at high pressure (10 to 80 atm). An avalanche is initiated between the electrodes by multiphoton ionization from a picosecond-scale laser pulse. The laser initiated electrons avalanche toward the anode and cause applied voltage to collapse in picoseconds, long before the hot current channel formation in a conventional sparkgap. The behavior is investigated of gas avalanche switches, a 2-D code, GAS2D, was developed which simultaneously and self consistently solves Maxwell's curl equations for transverse magnetic (TM) field modes in a gas between two parallel conductors along with a set of electron fluid conservation equations. A rectilinear perfect conductor may be placed between the parallel plates in the gas switching medium. DOE

N90-24552# Lawrence Livermore National Lab., CA.
MULTICHIP PACKAGING TECHNOLOGY WITH LASER-PATTERNED INTERCONNECTS
Andrew T. Barfknecht, David B. Tuckerman, James L. Kaschmitter, and Bruce M. McWilliams Apr. 1989 6 p Presented at the 39th Electronic Components Conference, Houston, TX, 22-24 May 1989
(Contract W-7405-eng-48)
(DE90-010743; UCRL-100808; CONF-8905102-2) Avail: NTIS HC A02/MF A01

A multichip silicon-on-silicon packaging technology was developed which incorporates laser-patterned thin-film interconnects. This technology is particularly suited for application in high speed, high power, and high I/O systems where its unique characteristics provide many advantages over more traditional methods. The laser-patterned thin-film interconnects allow higher I/O densities and better electrical performance than wire bonds or TAB. The face-up, thin-film eutectic die attach technique used provides much lower thermal resistance between the substrate and the chips than solder bump die attach can achieve. In addition, laser-patterned interconnects demonstrate superior ruggedness and fatigue resistance under thermomechanical cycling and shock. This technology was used to produce a 10-chip memory module, samples of which were tested to relevant methods of MIL-STD 883C. DOE

N90-24553# Argonne National Lab., IL.
RESISTIVITY MEASUREMENTS OF HALIDE-SALT/MgO SEPARATORS FOR THERMAL CELLS
Lazlo Redey, Margaret McParland, and Ron Guidotti 1990 5 p Presented at the 34th International Power Sources Symposium, Cherry Hill, NJ, 25-28 Jun. 1990 Prepared in cooperation with Sandia National Labs., Albuquerque, NM
(Contract DE-AC04-76DP-00789)
(DE90-009740; SAND-89-2342C; CONF-9006146-5) Avail: NTIS HC A01/MF A01

Resistivities of 20 compositions of halide-salt/MgO mixtures (various selections and percentages of LiF, LiCl, LiBr, KCl, KBr, CsBr, and MgO) to be used in Li-alloy/metal sulfide cells were measured at temperatures between the melting point of a particular mixture and 500 C. The resistivities were determined with cold pressed electrolyte-binder pellets by using a special cell and dc measuring technique. Temperature, salt composition, and MgO content were found to have a strong influence on resistivity. These factors are listed in decreasing order of the magnitude of the effect. The fabrication density (porosity) of the pellet also has some effect on resistivity. These measured resistivities provide a data base to select optimum compositions of electrolyte-binder pellets for LiSi/FeS2 thermal batteries and to calculate area-specific resistances of these components for battery modeling and optimization. DOE

N90-24554# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
APPLICATION OF ULTRACAPACITORS IN ELECTRIC VEHICLE PROPULSION SYSTEMS
A. F. Burke, J. E. Hardin, and E. J. Dowgiallo (Department of Energy, Washington, DC.) 1990 18 p Presented at the 34th International Power Sources Symposium, Cherry Hill, NJ, 25-28 Jun. 1990
(Contract DE-AC07-76ID-01570)
(DE90-010884; EGG-M-90200; CONF-9006146-6) Avail: NTIS HC A03/MF A01

Simulations of electric vehicles utilizing hybrid power sources showed that load leveling the main storage battery is a promising approach for reducing the design power requirements for the battery and increasing battery life. Significantly increased vehicle range should also result for batteries, which have been optimized for energy density at the lower peak power requirements made possible by load leveling. Consideration of the characteristics of ultracapacitors and bipolar lead-acid pulse batteries for the pulse power device indicate either device could be used, but the efficiency of the system would be greater by about 10 percent using the ultracapacitors. DOE

N90-24555# Idaho National Engineering Lab., Idaho Falls.
THE INEL BATTERY DATA BASE
A. F. Burke, J. E. Hardin, and D. M. Kiser 1990 12 p Presented at the International Lead Zinc Research Organization Meeting, San Francisco, CA, 27-28 Apr. 1990
(Contract DE-AC07-76ID-01570)
(DE90-010914; EGG-M-90202; CONF-9004196-1) Avail: NTIS HC A03/MF A01

The Department of Energy (DOE) has established a Battery Data Base for electric vehicle applications at the Idaho National Engineering Laboratory (INEL). The objectives of the Data Base are to collect, store, and make available to the electric vehicle community battery data from the INEL. Argonne National Laboratory, Sandia National Laboratory, and DOE battery contractors in forms appropriate for evaluating the batteries in electric vehicles. The Data Base currently includes data from over 500 test on 15 batteries of 5 different types. The data (over 120 MB) is stored on a 760 MB harddisk attached to a MicroVax 2. PC-based software to access the data was developed on the IBM PS/2 using dBASE 4. The initial version of the Data Base to be distributed on a single floppy disk is nearly complete. The first release will include the physical characteristics of the batteries, summary tables showing the test results for each cycle of the battery test programs, and some constant power discharge data for the batteries. Later versions of the Data Base will include second-by-second peak power and SFUDS data, which will require several floppy of Bernoulli disks to store the data. DOE

N90-24556# Academy of Sciences of the Ukrainian SSR, Kiev. Inst. Yadernykh Issledovanij.
AN INFLUENCE OF FAST NEUTRON IRRADIATION ON THE PROPERTIES OF P-I-N WIDE-BASED DIODES
I. E. Anokhin, L. I. Barabash, O. S. Zinets, A. B. Rosenfeld, and V. I. Khivrich 1988 20 p In RUSSIAN; ENGLISH summary
(DE90-611148; KIYI-88-45) Avail: NTIS (US Sales Only) HC A03/MF A01

The influence of fast neutron irradiation on the properties of p-i-n wide-based diodes made of high-resistivity Si at intermediate levels of injection is investigated theoretically and experimentally. It is shown that beside the change of minority carrier lifetime, one should account also for the change of equilibrium resistivity of Si under irradiation, moreover at doses greater than 2 to 3 krad the last factor contributes mainly to the shift of CVC of p-i-n diodes. Application of the wide-based p-i-n diodes made of high resistivity Si to measure the intermediate levels of injection will enable considerable extension of the range of fast neutron doses that could be measured by these diodes. Author

N90-24491# ETEL S.A., Motiers (Switzerland).
DESIGN AND USE OF BRUSHLESS dc MOTOR WITHOUT DETENT TORQUE
N. Wavre *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 197-201 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

N90-24507# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
ELECTRICAL CONNECTOR FOR OPERATION IN SPACE
Neil Cable and Y. Dohan (Souriau, Paray, France) *In its* Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 305-309 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N90-24557*# University of the Pacific, Stockton, CA. Dept. of Mechanical Engineering.
FLOW UNSTEADINESS EFFECTS ON BOUNDARY LAYERS
Final Report, Oct. 1985 - Sep. 1989
Sreedhara V. Murthy 1989 63 p
(Contract NCC2-357)
(NASA-CR-186067; NAS 1.26:186067) Avail: NTIS HC A04/MF A01 CSCL 20D

The development of boundary layers at high subsonic speeds in the presence of either mass flux fluctuations or acoustic disturbances (the two most important parameters in the unsteadiness environment affecting the aerodynamics of a flight vehicle) was investigated. A high quality database for generating detailed information concerning free-stream flow unsteadiness effects on boundary layer growth and transition in high subsonic and transonic speeds is described. The database will be generated with a two-pronged approach: (1) from a detailed review of existing literature on research and wind tunnel calibration database, and (2) from detailed tests in the Boundary Layer Apparatus for Subsonic and Transonic flow Affected by Noise Environment (BLASTANE). Special instrumentation, including hot wire

anemometry, the buried wire gage technique, and laser velocimetry were used to obtain skin friction and turbulent shear stress data along the entire boundary layer for various free stream noise levels, turbulence content, and pressure gradients. This database will be useful for improving the correction methodology of applying wind tunnel test data to flight predictions and will be helpful for making improvements in turbulence modeling laws. M.G.

N90-24558 Council for National Academic Awards (England).
FLOW STUDIES IN IMPELLER PASSAGES Ph.D. Thesis
Noor-E-Alam Ahmed 1988 489 p
Avail: Univ. Microfilms Order No. BRDX86776

The formulation of a computational code is described and the design of a novel laser Doppler anemometer for studying the boundary layers in high speed impeller passages. Detailed derivation of boundary layer equations in a non-orthogonal rotating coordinate system are presented. The code employs the momemtum integral equations in the streamwise (x-) and crossflow (z-) directions, a modified Head's entrainment, and the Ludwig Tillmans empirical frictionship. The Spence velocity profile is used for the streamwise direction and the form of the cross flow velocity profile is obtained from a simple theoretical consideration. Using the integral approach, the boundary layer solutions are obtained by viscous/inviscid interations. A quasi three dimensional code is used to obtain the inviscid solution. The shape parameter is employed to indicate flow separation and a modified lag-entrainment method is used to calculate boundary layers beyond separation. Corner and tip leakage effects are also incorporated using very simple models. Dissert. Abstr.

N90-24559 Pennsylvania State Univ., University Park.
A THEORETICAL ANALYSIS OF THE ACOUSTIC RADIATION FROM TWO-DIMENSIONAL TURBULENT MIXING LAYERS Ph.D. Thesis
Jiunn-Haur Shaw 1989 141 p
Avail: Univ. Microfilms Order No. DA9007926

Generation of small amplitude acoustic waves from two-dimensional mixing layers with/without external forcing is investigated. Each field is analyzed separately; they are linked through the Bernoulli enthalpy, which treats the flowfield as a composition of vertical, compressible flows; the vortical flow is incompressible and simulated with Lagrangian vortex dynamics, while acoustic waves are identified as unsteady compressible vortice-free motions, treated with linear analysis. For acoustic radiation from an unforced shear flow, results indicate that motions of large coherent structures contribute significantly to sound generation. Formation of large structures and subsequent pairing appear globally as a quadrupole source. Spectral analysis of the acoustic source in the streamwise direction suggests that the roll-up process is more energetic in generating high-frequency acoustic waves, while pairing of vortical structures provides a subharmonic mechanism for low-frequency oscillations. Because the pairing region covers a larger portion of the shear layer than does the roll-up region, the overall source strength in the pairing region dominates generation of acoustic waves and global wave motions. The acoustic wave generated from the entire shear layer reveals a broad-band distribution of frequencies with the dominant mode in the low-frequency range. To investigate effects of harmonic modulation on flow structures and acoustic wave patterns, forced shear layers with two different forcing frequencies are studied. Fourier analysis shows that a resonant process exists between the external forcing and the shear layer, causing vortices to coalesce into laterally distributed eddies. Flow development is characterized by three regimes: accelerated, impaired, and natural growth. The resonant process relaxes once pairing occurs; the ensuing power density spectrum of turbulent kinetic energy resembles that of the unforced case. Spectral analysis of the acoustic source suggests that external modulation enhances source energetics in regions where intrinsic flow frequencies match the forcing frequency. Dissert. Abstr.

N90-24560 Lehigh Univ., Bethlehem, PA.
VORTEX-INDUCED BOUNDARY-LAYER SEPARATION Ph.D. Thesis
Vellorie Jeanne Peridier 1989 337 p
Avail: Univ. Microfilms Order No. DA9008087

Unsteady boundary-layer separation at high Reynolds numbers, Re, is considered on a theoretical and computational basis. Whenever an external inviscid flow induces a region of adverse pressure gradient near a wall, the development of recirculating eddies in the boundary layer is common. An unsteady viscous-inviscid interaction often follows in the form of a local boundary-layer eruption and abrupt ejection of near-wall vorticity into the external flow. The dynamics of this process, as it develops in an initially thin boundary layer, is considered. As interaction ensues, the flow focuses into a band which progressively narrows in the streamwise direction. The complex flow development is extremely difficult to resolve using conventional Eulerian methods; the boundary-layer solutions are obtained using Lagrangian methods, where trajectories of a large number of fluid particles are computed. The algorithms developed are general but are applied to the problem of the boundary-layer induced by a two-dimensional vortex above an infinite plane wall. Solutions are obtained for the limit problem Re yields infinity, and for Re large but finite using an interacting boundary-layer approach. For the limit problem Re yields infinity, the boundary-layer solution develops a singularity at finite time, t(subs)(infinity), as the flow focuses toward an eruption. The multi-sturctured terminal state is the same as reached for the impulsively-started circular cylinder and found in recent asymptotic analysis. The interacting boundary-layer solutions are also shown to develop a singularity at finite times t(subs) (Re) is less than t(subs) (infinity). Thus, conventional interacting boundary-layer concepts do not alleviate the evolution of a singularity, but promote breakdown at an earlier time that decreases with Reynolds number. The computed results are found to be in excellent agreement with the interactive lengths and time scales predicted by recent asymptotic theories. The present results describe the initial stages of a strong unsteady viscous-inviscid interaction. Dissert. Abstr.

N90-24561 Texas Univ., Arlington.
INTERACTION OF THE LARGE EDDY STRUCTURE IN THE INNER-HALF OF A TURBULENT BOUNDARY LAYER Ph.D. Thesis
Myung Seong Kim 1989 134 p
Avail: Univ. Microfilms Order No. DA9010442

The Proper Orthogonal Decomposition procedure was applied to extract large-eddy structures from two-dimensional, flat-plate, turbulent boundary layer experimental data with zero pressure gradient in the intermediate region, roughly 0.03 is less than y/delta is less than 0.45. In order to solve Lumley's eigenvalue problem, two-point velocity correlations were taken from the experimental data of Grant and of Tritton. Two lines of investigation were performed; the first and primary method obtained direct solutions in totally physical space; the second obtained in a 'mixed' space of one physical coordinate and two wave-number coordinates because of the homogeneity assumptions in the streamwise(x) and spanwise(z) directions. Direct solution procedure revealed various structural patterns; more complex flow features are reduced to various simple pictures generating a better understanding of turbulent flow. Strong upward motion, paired vortical motion and highly elongated vortices were deduced from our six computed eigenmodes. A repetition of similar processes was observed, with a distinct and recognizable spacing in both spanwise and streamwise directions, corresponding to some cyclic process. Wave-number space solutions show two distinct structures, while direct solutions isolate a single eddy structure corresponding to each eigenmode. Furthermore, wave-number space solutions gave information about a dominant eddy structure corresponding to the largest eigenvalue which contains about 47 percent of the total turbulent kinetic energy. The solutions of both cases, wave-number space and direct solutions, showed very intense normal velocity components near the edge of wall region and that the flow is fully three-dimensional near y/delta = 0.2; above that altitude the

structure becomes two-dimensional. Finally, it is conjecture that there are accumulated regions between streamwise counter-rotating vortices elongated in the transverse direction, or hairpin-like vortices, which appear to play a role in the interaction between inner and outer layer. Dissert. Abstr.

N90-24562# Arizona Univ., Tucson. Dept. of Aerospace and Mechanical Engineering.
COHERENT STRUCTURES, CHAOS AND THE ROLE OF MODERN DYNAMICS IN TURBULENT SHEAR FLOWS Final Report, 1 Mar. 1988 - 28 Feb. 1989
Hermann F. Fasel and Alan C. Newell 2 Mar. 1990 105 p
(Contract N00014-85-K-0412; FQ8671-86-01551)
(AD-A220884) Avail: NTIS HC A06/MF A01 CSCL 20/4

The main objective is to investigate the relationships between modern concepts of nonlinear dynamical systems, chaos theory and fully turbulent boundary layers. The approach taken is to search for a connection between strange attractors and the large scale coherent structures which appear to play a dominant role in the dynamics of turbulent shear flows. The high Reynolds number turbulent boundary layer was attacked from two fronts: From the lower Reynolds number transitional boundary layers, which have the proper flow geometry but a lower Reynolds number and therefore lower dimensional dynamics; and from the high Reynolds number free shear layer flows, which have a simpler flow geometry than the fully turbulent boundary layer, but for which the coherent structures and their dynamics appear to be much simpler. Toward this end, a Proper Orthogonal Decomposition Technique was developed and applied to a forced plane mixing layer. Theoretical studies were also undertaken to understand the turbulent dissipation rates and the random occurrence of coherent events. GRA

N90-24563# Naval Postgraduate School, Monterey, CA.
NATURAL CONVECTION FORM AN ARRAY OF RECTANGULAR PROTRUSIONS IN AN ENCLOSURE FILLED WITH DIELECTRIC FLUID: EFFECTS OF BOUNDARY CONDITIONS, FLUID PRANDTL NUMBER, AND SELECTIVE POWERING M.S. Thesis
Mark E. Powell Sep. 1989 101 p
(AD-A219819) Avail: NTIS HC A06/MF A01 CSCL 13/1

An experimental investigation has been conducted to further examine Natural Convection Immersion Cooling of a three by three array of heated protrusions in a rectangular chamber filled with dielectric fluid. Each rectangular protrusion geometrically modelled a 20 pin dual inline package. Input power to each component varied from 0.1 to 3.0 W. The purpose of this study was to examine the effects of the following parameters for the range of power levels selected: (1) Top and bottom boundary temperatures; (2) Selective powering of components; and (3) Changes in the fluid Prandtl number. The data were obtained as component surface temperatures. These were subsequently presented in terms of appropriate non-dimensional parameters. As part of the overall investigation, flow visualization results are also presented for selected conditions. GRA

N90-24564# Naval Postgraduate School, Monterey, CA.
OFF-DESIGN LOSS MEASUREMENTS IN A COMPRESSOR CASCADE M.S. Thesis
Michael A. Classick Sep. 1989 179 p
(AD-A220094) Avail: NTIS HC A09/MF A01 CSCL 20/4

Data acquisition software was written to recover the ability to make loss measurements using a five-hole pneumatic probe in a wind tunnel facility currently containing a modeled subsonic cascade of controlled diffusion (CD) stator blades. Acquisition, reduction and ancillary programs were written for a Hewlett Packard 9000 Series 300 computer/HP 3052 Data Acquisition System in HP BASIC 5.0. The new software was demonstrated and validated by conducting a set of surveys at the (near to stall) air inlet flow angle of 48 degrees. The survey results showed a diminishing core of two-dimensional flow through the blading due to side wall boundary layer effects, and integration of upstream and downstream measurements gave an axial velocity-density ratio of 1.108 and a NASA loss coefficient of 0.097. Prior to the surveys, the probe was calibrated in a free jet facility, thus also revalidating the calibration software. It was concluded that the facility instrumentation and procedures were now in place for making accurate off-design loss measurements on a routine basis. GRA

N90-24565# Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
FLUID DYNAMIC AND ACOUSTIC EXPERIMENTS ON TURBOMACHINE ROTORS SUBJECT TO VARIABLE FLOW CONDITIONS Annual Report, 1 Apr. 1989 - 31 Mar. 1990
Patrick F. Dunn and Thomas J. Mueller 31 Mar. 1990 29 p
(Contract N00014-89-J-1783)
(AD-A220298) Avail: NTIS HC A03/MF A01 CSCL 20/4

The primary objective of this research is to obtain a better understanding of how inflow nonuniformities interact with rotor blades, thereby producing rotor vibrations and the radiation of unwanted noise. Carefully controlled experiments will be conducted in low speed wind tunnels using an advanced rotor-dynamometer system. The fluid mechanical characteristics of the inflow will be documented and related to performance and blade radiated sound. The blade response, as characterized by its thrust, torque, surface pressure distribution and radiated sound, will be measured for the cases of both steady and unsteady inflows of variable turbulence intensity and scale. GRA

N90-24566*# Analytical Services and Materials, Inc., Hampton, VA.
EFFECT OF SUCTION ON CONTROLLING THE SECONDARY INSTABILITY OF BOUNDARY LAYERS Final Report
Nabil M. El-Hady Washington Jul. 1990 37 p
(Contract NAS1-18599)
(NASA-CR-4306; NAS 1.26:4306) Avail: NTIS HC A03/MF A01 CSCL 20D

The effect of suction on controlling the 3-D secondary instability is investigated for a boundary layer with pressure gradient in the presence of small but finite amplitude Tollmien-Schlichting wave. The focus is on principal parametric resonance responsible for strong growth of subharmonics in low disturbance environment. Calculations are presented for the effect of suction on the onset and amplification of the secondary instability in Blasius and Falkner-Skan flows, as well as its effect on controlling the production of the vortical structure. Author

N90-24567# Technische Univ., Eindhoven (Netherlands).
SYMMETRY IN THE DYNAMICS OF A POLARIZED FLUID Ph.D. Thesis
Johannes Wilhelmus M Lodewijk 1989 192 p
(ETN-90-96896) Avail: NTIS HC A09/MF A01

A detailed examination for the symmetries of a variational principal for a perfect fluid and a study of the coupling of the fluid with an electromagnetic field are presented. Algebraic structures for both constants of the motion and underlying symmetries, with emphasis on Lagrangian and Hamiltonian formulations, are summarized. The kinematical part of the geometrical problem, in terms of a time dependent bijection, is explained. The dynamical part of the perfect fluid motion is introduced. Galilean invariance was imposed on a class of fluid Lagrangians. The Lagrangian description of the fluid was linearized. The momentum problem for electromagnetic field in a polarized fluid was addressed. The approach does not lead to a Lorentz-invariant splitting, other than a splitting that involves the field in vacuo. The contribution of the total electromagnetic field in a polarized fluid to the total momentum of the coupled system is confirmed to be EH/C squared. ESA

N90-24568# Groningen Rijksuniv. (Netherlands). Dept. of Mathematics.
MASS TRANSFER INDUCED CONVECTION NEAR GAS-LIQUID INTERFACES Ph.D. Thesis
Hendrik Anton Dijkstra 1988 162 p
(Grant GWI-44-0625)
(ETN-90-96925) Avail: NTIS HC A08/MF A01

The Rayleigh-Benard-Marangoni instability of a two component

liquid layer confined to a two dimensional rectangular container is studied. Linear stability questions of such a motionless liquid layer are answered. The effects of initial conditions on the transient flow development from an unstable motionless state are studied numerically. Several nonlinear phenomena, particulary the interaction of unstable patterns, are studied. In a certain parameter range two linearity stable steady flow state exist. The complete structure of steady solutions is determined. The local enhancement of mass flux due to the creeping of a liquid film up a vertical wall is shown proportional to a specific quantity. A model is given as a step to the description of the effect of surface tension gradients on the mass transfer in packed columns. ESA

N90-24569# Massachusetts Inst. of Tech., Cambridge. Computational Fluid Dynamics Lab.
COMPUTATIONAL MODELING OF THREE-DIMENSIONAL COMPRESSIBLE LEADING EDGE VORTICES Final Report, 15 Feb. 1986 - 31 Jan. 1990
Earll M. Murman 10 Apr. 1989 31 p
(Contract N00014-86-C-0288)
(AD-A221022; MIT-97568) Avail: NTIS HC A03/MF A01 CSCL 20/4

The research focussed on the accurate computation of compressible leading-edge vortex flows with interpretation and understanding of the results. To this end, a number of investigations were undertaken, starting with the conical Euler equation model and concluding with fully three-dimensional Navier-Stokes equation calculations. Considerable emphasis was placed on: (1) Comparisons of Euler with Navier-Stokes calculations to understand the origins of various mechanisms; (2) Comparison of calculations with experiments both to determine the accuracy of the calculations and to comprehend the physical processes; and (3) Interpretation of the results with the aid of analytical models. GRA

N90-24570*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE MODELING OF DROP-CONTAINING TURBULENT EDDIES Final Report, 1 Oct. 1986 - 30 Sep. 1989
Josette Bellan Nov. 1989 235 p
(AF Proj. 2308)
(NASA-CR-186805; NAS 1.26:186805; AD-A221050; AFOSR-90-0500TR) Avail: NTIS HC A11/MF A02 CSCL 20/4

Formulae are presented for spherical clusters of evaporating drops in axial flows and cylindrical clusters of evaporating drops in vortical flows. In both situations the formula is valid for dense and dilute clusters of drops. It is shown that evaporation of dense, spherical clusters of drops is substantially influenced by turbulence. Dense clusters of drops embedded in low turbulence surroundings initially contract due to evaporative cooling; modest expansion follows due to hot gas eventually entering the cluster. Dense clusters of drops embedded in high turbulence surroundings experience a short initial period of evaporative cooling which is followed by substantial cluster expansion. In contrast, the evaporation of dilute clusters of drops is not sensitive to turbulence; minimal cooling of the gas results in a minimal contraction with no expansion to follow. The evaporation time of the dense, cylindrical clusters of drops in vortical flows is mainly controlled by the initial solid body rotation of the drops. Evaporation time is a strong decreasing function of the air/fuel mass ratio in the dense cluster regime and asymptotically levels off in the dilute cluster regime. As the drops evaporate they move out radially forming a cylindrical shell around the center of the vortex. Both the final to initial volume ratio and the final to initial shell thickness ratio are decreasing functions of the initial air/fuel mass ratio. GRA

N90-24571# High Technology Corp., Hampton, VA.
NONLINEAR DEVELOPMENT OF GOERTLER AND CROSSFLOW VORTICES AND GOERTLER/TOLLMIEN-SCHLICHTING WAVE INTERACTION Final Report, 1 Jul. - 31 Dec. 1989
M. R. Malik and A. A. Godil 26 Feb. 1990 70 p
(Contract F49620-89-C-0093; AF Proj. 2307)
(AD-A221107; HTC-9001; AFOSR-90-0386TR) Avail: NTIS HC A04/MF A01 CSCL 20/4

The problem of nonlinear development of Goertler vortices on a curved wall is studied within the framework of incompressible Navier-Stokes equations which are solved by a Fourier-Chebyshev spectral method. The results show that higher harmonics grow due to nonlinear effects; however, most of the energy remains in the fundamental mode. The computed flow field in the presence of a Goertler vortex is in qualitative agreement with the experimental data. The interaction of the Goertler vortex with a two-dimensional Tollmien-Schlichting wave is also studied and it is shown that the Tollmien-Schlichting wave grows faster than its linear theory growth rate when the amplitude of the Goertler vortex is sufficiently large. Due to nonlinear effects this interaction further leads to the development of oblique waves with spanwise wavelength equal to the Goertler vortex wavelength. The numerical method is also applied to study the nonlinear development of a stationary crossflow vortex in a Falkner-Skan-Cooke boundary layer. The crossflow vortex develops in a manner similar to that found earlier for rotating disk flow. The fundamental and the higher harmonics all tend to saturate when the integration is carried to large amplitudes. The computed velocity distribution clearly shows the emergence of the superharmonic which, however, does not dominate the fundamental mode. GRA

N90-24572# Pennsylvania State Univ., University Park. Applied Research Lab.
A LASER-INDUCED FLUORESCENCE TECHNIQUE FOR MEASUREMENT OF SLOT-INJECTED FLUID CONCENTRATION PROFILES IN A PLATE TURBULENT BOUNDARY LAYER
T. A. Brungart and H. L. Petrie May 1990 106 p Sponsored by David Taylor Research Center, Bethesda, MD
(AD-A221388; ARL/PSU/TR-90-006) Avail: NTIS HC A06/MF A01 CSCL 20/4

A technique for measuring near instantaneous concentration profiles of a fluid injected through a narrow inclined slot at the wall into a high unit Reynolds turbulent boundary layer is discussed. The concentration profiles are determined by measuring the light intensity emitted from a fluorescent dye premixed into the injectant flow as the injectant convects through an excitation laser beam. The fluorescence intensity is quantified by an electronically shuttered single stage microchannel plate image intensifier coupled to a linear photodiode array. This high resolution technique is being used to study the diffusion of injected polymer solutions away from the near wall region in a flat plate turbulent boundary layer where these solutions are effective in reducing drag. GRA

N90-24573# Technische Univ., Berlin (Germany, F.R.). Fachbereich fuer Verkehrswesen.
METHODS OF PERTURBATION THEORY AS A MEANS FOR INTERACTIVE DESIGN FROM BODIES IN A FLOW Ph.D. Thesis [METHODEN DER STOERUNGSTHEORIE ALS HILFSMITTEL FUER DEN INTERAKTIVEN ENTWURF VON UMSTROEMTEN KOERPERN]
Andreas Kraus 1989 113 p In GERMAN
(ETN-90-96502) Avail: NTIS HC A06/MF A01

The implementation possibilities of perturbation methods are examined to rapidly calculate the influence of form variations on the flow field of a body. For the potential flow around deeply immersed bodies it is shown how, with perturbation terms, a linear and rapidly evaluable relation can be established between perturbations of the body geometry and of the velocity distribution. The inverse problem can be solved in the same way. Perturbation relations for bidimensional or three dimensional problems can be established. For a given geometry, examples showed a good approximation of the velocity perturbation. The problem of the potential flow with free surface can be solved by a Rankine source method. ESA

N90-24574# Lawrence Livermore National Lab., CA.
TURBULENCE MODELING IN THE SHALE CODE

C. E. Leith and L. G. Margolin Mar. 1990 30 p
(Contract W-7405-eng-48)
(DE90-010354; UCRL-ID-103271) Avail: NTIS HC A03/MF A01

Two turbulence models were embedded in the 2-D fluid code SHALE. A K-(var epsilon) model, which describes the average mixing due to turbulence, has been modified to include terms relating to compressible flows. In addition, a subgrid-scale K-(lambda) model including stochastic backscatter provides realizations of random, but resolvable structures. A brief description is provided of the two models and also of the initialization of the turbulence in the numerical calculation. The details are also discussed of the algorithms and their implementation in SHALE. Calculations are shown of the evolution of a shear mixing layer, using the K-(lambda) model. DOE

N90-24575# Idaho National Engineering Lab., Idaho Falls.
NDE (NONDESTRUCTIVE EVALUATION) OF CERAMIC HEAT EXCHANGERS
John R. Bower (Babcock and Wilcox Co., Lynchburg, VA.) 1990 12 p Presented at the Society for Experimental Mechanics Conference, Albuquerque, NM, 4-6 Jun. 1990
(Contracts DE-AC07-76ID-01570; DE-FC07-89ID-12887)
(DE90-010977; EGG-M-90096; CONF-9006124-5) Avail: NTIS HC A03/MF A01

NonDestructive Evaluation (NDE) is needed both to support the modeling for the initial design of ceramic components and to perform acceptance testing of the finished parts. Results of development of NDE techniques for ceramic heat exchangers are presented. DOE

N90-24576# California Univ., Berkeley. Lawrence Berkeley Lab. Earth Sciences Div.
THEORETICAL STUDIES OF NON-NEWTONIAN AND NEWTONIAN FLUID FLOW THROUGH POROUS MEDIA Ph.D. Thesis
Yu-Shu Wu Feb. 1990 253 p Prepared in cooperation with California Univ., Berkeley
(Contract DE-AC03-76SF-00098)
(DE90-011610; LBL-28642) Avail: NTIS HC A12/MF A02

A comprehensive theoretical study was performed on the flow behavior of both single and multiple phase non-Newtonian fluids in porous media. This work is divided into three parts: development of numerical and analytical solutions; theoretical studies of transient flow of non-Newtonian fluids in porous media; and applications of well test analysis and displacement efficiency evaluation to field problems. A fully implicit, integral finite difference model was developed for simulation of non-Newtonian and Newtonian fluid flow through porous media. Several commonly-used rheological models of power-law and Bingham plastic non-Newtonian fluids were incorporated in the simulator. A Buckley-Leverett type analytical solution for one-dimensional, immiscible displacement involving non-Newtonian fluids in porous media was developed. An integral method is also presented for the study of transient flow of Bingham fluids in porous media. In addition, two well test analysis methods were developed for analyzing pressure transient tests of power-law and Bingham fluids, respectively. Applications are included to demonstrate this new technology. The physical mechanisms involved in immiscible displacement with non-Newtonian fluids in porous media were studied using the Buckley-Leverett type analytical solution. In another study, an idealized fracture model was used to obtain some insights into the flow of a power-law fluid in a double-porosity medium. Transient flow of a general pseudoplastic fluid was studied numerically. DOE

N90-24229# National Aerospace Lab., Amsterdam (Netherlands).
MISSION OF LARVE
H. Hagmeijer and K. J. Sudmeijer *In* Technische Univ. Berlin, Test and Measurement Technique in Hypersonics Jun. 1989 p 58-72 Sponsored by Netherlands Agency for Aerospace Programs (For primary document see N90-24225 18-01)
Avail: NTIS HC A04/MF A01

N90-24996*# Minnesota Univ., Minneapolis. Dept. of Aerospace Engineering and Mechanics.
FINITE ELEMENT FORMULATIONS FOR COMPRESSIBLE FLOWS Final Report
Tayfun E. Tezduyar *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 8 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 20D

N90-25051*# Maine Univ., Orono. Dept. of Mathematics.
AN ANALYTIC STUDY OF NONSTEADY TWO-PHASE LAMINAR BOUNDARY LAYER AROUND AN AIRFOIL Abstract Only
Yu-Kao Hsu *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 86-88 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20D

N90-25064*# College of William and Mary, Williamsburg, VA. Dept. of Mathematics.
KHARITONOV'S THEOREM: GENERALIZATIONS AND ALGORITHMS Abstract Only
George Rublein *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 135-136 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20D

N90-25065*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
GENERATION OF CIRCUMFERENTIAL VELOCITY CONTOURS ASSOCIATED WITH PULSED POINT SUCTION ON A ROTATING DISK
Gregory V. Selby *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 137-140 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 04B

N90-25067*# Florida Inst. of Tech., Melbourne. Dept. of Mechanical and Aerospace Engineering.
COMPUTATIONAL SIMULATION OF TRANSITION TO TURBULENCE THROUGH INVERSE MODELING Abstract Only
Paavo Sepri *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship program 1989 Sep. 1989 p 146-147 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 22B

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N90-24577# Norges Tekniske Hoegskole, Trondheim. Applied Optics Group.
USE OF THE XYBION ISG-CAMERA IN THE RETRA-1000 TV-HOLOGRAPHY UNIT Final Report, 1 May - 31 Oct. 1989
Ole J. Lokberg 31 Dec. 1989 20 p
(Grant AF-AFOSR-0328-89)
(AD-A219842; EOARD-TR-90-04) Avail: NTIS HC A03/MF A01 CSCL 14/1

A Xybion intensified CID-camera has been tested in the Retra

1000 TV-holography instrument. Apart from spurious oscillations in the amplifier chain, the camera-Retra combination was easy to use. Deformation and vibration fringe patterns of good quality were obtained both at room temperature and at object temperatures close to + 1500 C. The overall gain in light sensitivity was only marginal compared to standard video cameras. This somewhat unexpected result is due to the heterodyne recording in the holographic system where a strong reference wave with inherent low loss allows for detection of very low object intensities. The use of intensified cameras like the Xybion is of interest for use in TV-holography due to the easy gating of the laser light which results in greater fringe stability and the possible attainment of very high object temperatures when combined with a pulsed laser. GRA

N90-24578# Research Inst. of National Defence, Linkoeping (Sweden). Dept. of Information Technology.
EVALUATION OF SCINTILLOMETER
Peter Noren Oct. 1989 68 p In SWEDISH; ENGLISH summary
(FOA-C-30546-3.1; LiTH-ISY-EX-0929; ISSN-0347-3708; ETN-90-96587) Avail: NTIS HC A04/MF A01; Research Inst. of National Defence, Box 1165, S-581 11 Linkoeping, Sweden, 50 Swedish crowns

A laser system which measures the atmospheric turbulence by reflecting a laserbeam in a retroreflector, with the transmitter and the receiver placed in the same unit, was constructed. The measuring equipment is described and results achieved are recorded. Before constructing the terminal version of the scintillation counter, certain points must be improved,including: suppression of the fluctuations that occur in high stress; another laser must be tested to suppress interference perturbations; the demodulator must be changed. A more powerful computer is desirable. ESA

N90-24579# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abt. Systemtechnik und Navigation.
ANGLE MEASUREMENTS USING THE LASER GYRO GG 1342
Volker Wetzig, Egmar Luebeck, Wolfram Pahl, Dieter Ullrich, and Reiner Wittekopf (Physikalisch-Technische Bundesanstalt, Brunswick, Germany, F.R.) Oct. 1989 94 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1212)
(DLR-FB-89-50; ISSN-0171-1342; ETN-90-96456; ESA-TT-1212) Avail: NTIS HC A05/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 29 DM

The applicability of laser gyroscopes for static and dynamic angle measurements was investigated using a series production model Honeywell GG 1342 with dither bias compensation. For the static measurements a 12-sided mirror polygon with a photoelectric autocollimation telescope was used as an angle reference. For the dynamic measurements the inductosyn of a gyro test table served as a reference. It is shown that the laser gyro can be used for the fine calibration of a precision angle transducer. The effects of gyro scale factor and drift variations on the accuracy of angle measurements were analyzed. The quantization noise was reduced in the data processing on the basis of fast sampling. For non-repeatable angle measurements the random walk drift is the limiting factor for the angle measurements accuracy. ESA

N90-24580# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Hochfrequenz-Verfahren.
NAVIGATION EXPERIMENT NAVEX: MEASUREMENTS AND PERFORMANCE OF THE SPACEBORNE CLOCKS
Jens Hammesfahr Feb. 1988 60 p In GERMAN; ENGLISH summary
(DLR-FB-89-43; ISSN-0171-1342; ETN-90-96485) Avail: NTIS HC A04/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 23 DM

The applicability of the NAVEX space clocks was tested in Spacelab. The rates of the cesium and the rubidium clock, which are part of the spaceborne equipment, were calculated against a ground reference atomic clock at distinct time intervals. This was performed on the ground as well as during the space mission. The rates were derived considering thermal and relativistic effects. The comparison between the rates on the ground and in space show that commercial atomic clocks can be used in space with good results. ESA

N90-24581# Technische Univ., Brunswick (Germany, F.R.). Fakultaet fuer Maschinenbau und Elektrotechnik.
THE TARGET PURSUIT OF GIOTTO CAMERA Ph.D. Thesis [DIE ZIELVERFOLGUNG DER GIOTTO-KAMERA]
Edgar Krahn 1989 209 p In GERMAN
(ETN-90-96496) Avail: NTIS HC A10/MF A01

The target pursuit of the Giotto camera is critically analyzed by its voyage near the Halley's comet. The remarked irregularities are represented and examined and improvements for future missions are projected. The process is based on an evaluation of the time development of the angle between the flight direction and the direction of the object. Instead of the spatial angle, its projection on the focal plane was considered. This approximation process, used for a cost reduction, is a good alternative to exact calculation process in spheric coordinates in case of small angles of observation. The irregularities cannot be reduced by the implemented algorithm but can be taken into account in the calculations. ESA

N90-24582# Beleidscommissie Remote Sensing, Delft (Netherlands).
MODIFICATIONS OF THE DUTSCAT SYSTEM [AANPASSINGEN DUTSCAT]
P. Snoeij, R. J. Groenveld, and P. Hakkart (Technische Univ., Delft, Netherlands) Dec. 1989 87 p In DUTCH
(BCRS-89-33; ETN-90-96790) Avail: NTIS HC A05/MF A01

The shortcomings of the multiband coherent pulse scatterometer DUTSCAT (Delft University of Technology Scatterometer) and methods for improvements are discussed. The reading of the attenuator state can be improved by changing the control panel and the wiring. The internal calibration can be improved by using PIN high frequency switches, by changing the delay line configuration, and by increasing the sampling frequency of the digital part. The simultaneous measurement of two polarizations requires several additional switches and the modification of the digital part. The existing digital processor has to be equipped with microprocessor as control unit. The measurement of the phase of the polarization requires extensive and expensive modifications. ESA

N90-24583# Aeronautical Research Labs., Melbourne (Australia).
PERIPHERY CAMERA SYSTEM
F. Pritchard Oct. 1989 19 p
(AD-A221281; ARL-FLIGHT-MECH-TM-415; DODA-AR-005-646) Avail: NTIS HC A03/MF A01 CSCL 14/4

The ARL Combustion Group requested the Photographic Section to photograph a TF30 engine flame tube in support of Task 86/036. The photograph was to show the complete external surface of the cylindrical flame tube as a flat plane (i.e., a rolled out flat view). The technique of Periphery Photography was chosen whereby photographs are obtained by rotating the flame tube in front of a camera fitted with a movable film back. For this particular task existing equipment that was used to photograph a flame tube 630 mm in height by 140 mm in diameter was modified. The new flame tube measured 312 mm in height by 170 mm in diameter. This required new calculations to locate the camera assembly, extension guide rails, pulleys and switches. GRA

N90-24584*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
REMOTE MEASUREMENT OF ICE THICKNESS ON THE SHUTTLE EXTERNAL TANK SURFACE

Jag J. Singh Jun. 1990 13 p
(NASA-TM-102667; NAS 1.15:102667) Avail: NTIS HC A03/MF A01 CSCL 14B

A passive technique is proposed for remote measurement of thickness of the ice layer formed on the external tank surface of the Shuttle during the T-2 hours period before launch. It is based on the comparison of the ratios of the intensities of three preselected near-IR wavelength bands scattered from the (test spot) and a neighboring (reference spot) on the tank surface. The Shuttle is uniformly illuminated by a battery of strategically located solar simulator lamps and banks of incadescent lamps during prelaunch period. Thus, there should be adequate radiation in the three selected bands incident on the external tank surface during the test period. It is planned to conduct a feasibility study of the proposed technique before recommending it to the KSC/SSC teams for adoption. Author

N90-24500# Centre National d'Etudes Spatiales, Toulouse (France).
SPOT 4 MAGNETIC TAPE RECORDER MECHANISMS
A. Borrien, E. Vialatoux, J. L. Lhermet, and A. Didier (Schlumberger Industries, Velizy, France) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 257-265 In FRENCH; ENGLISH summary (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

N90-24994*# DePaul Univ., Chicago, IL. Dept. of Computer Science.
A COMPARISON OF SELECT IMAGE-COMPRESSION ALGORITHMS FOR AN ELECTRONIC STILL CAMERA Final Report
Rosalee Nerheim *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 11 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 14B

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N90-24585*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DIODE LASER SATELLITE SYSTEMS FOR BEAMED POWER TRANSMISSION
M. D. Williams, J. H. Kwon (Miami Univ., Oxford, OH.), G. H. Walker, and D. H. Humes Washington 1990 31 p
(NASA-TP-2992; L-16669; NAS 1.60:2992) Avail: NTIS HC A03/MF A01 CSCL 20E

A power system composed of an orbiting laser satellite and a surface-based receiver/converter is described. Power is transmitted from the satellite to the receiver/converter by laser beam. The satellite components are: (1) solar collector; (2) blackbody; (3) photovoltaic cells; (4) heat radiators; (5) laser system; and (6) transmission optics. The receiver/converter components are: receiver dish; lenticular lens; photocells; and heat radiator. Although the system can be adapted to missions at many locations in the solar system, only two are examined here: powering a lunar habitat; and powering a lunar rover. Power system components are described and their masses, dimensions, operating powers, and temperatures, are estimated using known or feasible component capabilities. The critical technologies involved are discussed and other potential missions are mentioned. Author

N90-24586*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
LOW-TEMPERATURE CO-OXIDATION CATALYSTS FOR LONG-LIFE CO2 LASERS
David R. Schryer, ed. and Gar B. Hoflund, ed. (Florida Univ., Gainesville.) Washington Jun. 1990 404 p Conference held in Hampton, VA, 17-19 Oct. 1989; sponsored by NASA, Washington and the Royal Signals and Radar Establishment, Malvern, England
(NASA-CP-3076; L-16797; NAS 1.55:3076) Avail: NTIS HC A18/MF A03 CSCL 20E

Low-temperature CO-oxidation catalysts are necessary for closed-cycle pulsed CO2 lasers as well as for other applications, including air purification. The papers presented in this volume discuss several such catalysts, including information on catalyst preparation, techniques for enhancing catalyst performance, laboratory and laser test results, and mechanistic considerations. For individual titles, see N90-24587 through N90-24616.

N90-24587*# Royal Signals and Radar Establishment, Malvern (England).
PULSED-DISCHARGE CARBON DIOXIDE LASERS
David V. Willetts *In* NASA, Langley Research Center, Low Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 3-19 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 20E

The purpose is to attempt a general introduction to pulsed carbon dioxide lasers of the kind used or proposed for laser radar applications. Laser physics is an excellent example of a cross-disciplinary topic, and the molecular spectroscopy, energy transfer, and plasma kinetics of the devices are explored. The concept of stimulated emission and population inversions is introduced, leading on to the molecular spectroscopy of the CO2 molecule. This is followed by a consideration of electron-impact pumping, and the pertinent energy transfer and relaxation processes which go on. Since the devices are plasma pumped, it is necessary to introduce a complex subject, but this is restricted to appropriate physics of glow discharges. Examples of representative devices are shown. The implications of the foregoing to plasma chemistry and gas life are discussed. Author

N90-24588*# California Univ., San Diego. Chemical Engineering Group.
CO-OXIDATION CATALYSTS: LOW-TEMPERATURE CO OXIDATION OVER NOBLE-METAL REDUCIBLE OXIDE (NMRO) CATALYSTS **c25**
Richard K. Herz *In* NASA, Langley Research Center, Low Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 21-40 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

Oxidation of CO to CO2 is an important reaction technologically and environmentally and a complex and interesting reaction scientifically. In most cases, the reaction is carried out in order to remove CO as an environmental hazard. A major application of heterogeneous catalysts is catalytic oxidation of CO in the exhaust of combustion devices. The reaction over catalysts in exhaust gas is fast and often mass-transfer-limited since exhaust gases are hot and O2/CO ratios are high. The main challenges to catalyst designers are to control thermal sintering and chemical poisoning of the active materials. The effect of the noble metal on the oxide is discussed, followed by the effect of the oxide on the noble metal, the interaction of the noble metal and oxide to form unique catalytic sites, and the possible ways in which the CO oxidation reaction is catalyzed by the NMRO materials. Author

N90-24589*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
Pt/SnO2-BASED CO-OXIDATION CATALYSTS FOR LONG-LIFE CLOSED-CYCLE CO2 LASERS
David R. Schryer, Billy T. Upchurch, Robert V. Hess, George M. Wood, Barry D. Sidney, Irvin M. Miller, Kenneth G. Brown, John D. VanNorman, Jacqueline Schryer, and David R. Brown (Old Dominion Univ., Norfolk, VA.) et al *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 41-53 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 20E

Noble-metal/tin-oxide based catalysts such as Pt/SnO2 have been shown to be good catalysts for the efficient oxidation of CO

at or near room temperature. These catalysts require a reductive pretreatment and traces of hydrogen or water to exhibit their full activity. Addition of Palladium enhances the activity of these catalysts with about 15 to 20 percent Pt, 4 percent Pd, and the balance SnO2 being an optimum composition. Unfortunately, these catalysts presently exhibit significant decay due in part to CO2 retention, probably as a bicarbonate. Research on minimizing the decay in activity of these catalysts is currently in progress. A proposed mechanism of CO oxidation on Pt/SnO2-based catalysts has been developed and is discussed. Author

N90-24590*# United Kingdom Atomic Energy Authority, Harwell (England).

THE OXIDATION OF CARBON MONOXIDE USING TIN OXIDE BASED CATALYSTS

Christopher F. Sampson and Norman Jorgensen *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 57-68 Sponsored by Ministry of Defence, England (For primary document see N90-24586 18-36)

Avail: NTIS HC A18/MF A03 CSCL 20E

The preparation conditions for precious metal/tin oxide catalysts were optimized for maximum carbon monoxide/oxygen recombination efficiency. This was achieved by controlling the tin digestion, the peptization to form the sol, the calcination process and the method of adding the precious metals. Extensive studies of the tin oxide structure were carried out over the temperature range 20 to 500 C in air or hydrogen environments using Raman scattering and X ray diffraction. Adsorbed species on tin oxide, generated in an environment containing carbon monoxide, gave rise to a Raman band at about 1600 cm(exp -1) which was assigned to carbonaceous groups, possible carbonate. Author

N90-24591*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

LaRC-DEVELOPED CATALYSTS FOR CO2 LASERS

Billy T. Upchurch, Erik J. Kielin, and Irvin M. Miller (Science and Technology Corp., Hampton, VA.) *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 69-90 (For primary document see N90-24586 18-36)

Avail: NTIS HC A18/MF A03 CSCL 20E

Pulsed CO2 lasers have many remote sensing applications from space, airborne, and ground platforms. The NASA Laser Atmospheric Wind Sounder (LAWS) system will be designed to measure wind velocities from polar earth orbit for a period of up to three years. Accordingly, this and other applications require a closed-cycle pulsed CO2 laser which necessitates the use of an efficient CO-O2 recombination catalyst for these dissociation products which otherwise would degrade the laser operation. The required catalyst must not only operate at low temperatures but also must operate efficiently for long time periods. The research effort at NASA LaRC has centered around development and testing of CO oxidation catalysts for closed-cycle, pulsed, common and rare-isotope CO2 lasers. Researchers examined available commercial catalysts both in a laser and under simulated closed-cycle laser conditions with efforts aimed toward a thorough understanding of the fundamental catalytic reaction. These data were used to design and synthesize new catalyst compositions to better meet the catalyst requirements for closed-cycle pulsed CO2 lasers. Syntheses and test results for catalysts developed at Langley Research Center which have significantly better long-term decay characteristics than previously available catalysts and at the same time operate quite well under lower temperature conditions are discussed. Author

N90-24592*# Phillips Petroleum Co., Bartlesville, OK. Dept. of Research and Development.

PHILLIPS CO-OXIDATION CATALYTS FOR LONG-LIVED CO2 LASERS: ACTIVITY AND INITIAL CHARACTERIZATION STUDIES

J. H. Kolts, D. J. Elliott, and F. Pennella *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 91-101 (For primary document see N90-24586 18-36)

Avail: NTIS HC A18/MF A03 CSCL 20E

Four different catalysts have been developed specifically for use in sealed carbon dioxide lasers. The catalysts have been designed to be low dusting, stable to shock and vibration, have high activity at low temperatures and have long active lifetimes. Measured global CO oxidation rates range from 1.4 to 2.2 cc CO converted per minute per gram of catalyst at ambient temperature. The catalysts also retain substantial activity at temperatures as low as -35 C. The Phillips laser catalysts are prepared in a variety of different shapes to meet the different pressure drop and gas flow profiles present in the many different styles of lasers. Each catalyst has been tested in sealed TEA lasers and has been shown to substantially increase the sealed life of the laser. Activity measurements made on the precious metal catalysts which were prepared with and without activity promoters showed that the promoter materials increase catalyst CO oxidation activity at least an order of magnitude at ambient temperature. Initial studies using H2 and CO chemisorption, X ray diffraction (XRD) and X ray photoelectron spectroscopy (XPS) have shown that the activity promoters do not significantly affect the precious metal crystallite size or the electronic structure around the precious metal. In addition, the formation or lack of formation of solid solutions between the precious metal and promoters has also been shown not to affect the activity of the promoted catalyst. Author

N90-24593*# Hughes Aircraft Co., El Segundo, CA. Electro-Optical and Data Systems Group.

SYNTHESIS, CHARACTERIZATION AND EVALUATION OF CO-OXIDATION CATALYSTS FOR HIGH REPETITION RATE CO2 TEA LASERS

Thomas P. Moser *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 103-121 (For primary document see N90-24586 18-36)

Avail: NTIS HC A18/MF A03 CSCL 20E

An extremely active class of noble metal catalysts supported on titania was developed and fabricated at Hughes for the recombination of oxygen (O2) and carbon monoxide (CO) in closed-cycle CO2 TEA lasers. The incipient wetness technique was used to impregnate titania and alumina pellets with precious metals including platinum and palladium. In particular, the addition of cerium (used as an oxygen storage promoter) produced an extremely active Pt/Ce/TiO2 catalyst. By comparison, the complementary Pt/Ce/ gamma-Al2O3 catalyst was considerably less active. In general, chloride-free catalyst precursors proved critical in obtaining an active catalyst while also providing uniform metal distributions throughout the support structure. Detailed characterization of the Pt/Ce/TiO2 catalyst demonstrated uniform dendritic crystal growth of the metals throughout the support. Electron spectroscopy for Chemical Analysis (ESCA) analysis was used to characterize the oxidation states of Pt, Ce and Ti. The performance of the catalysts was evaluated with an integral flow reactor system incorporating real time analysis of O2 and CO. With this system, the transient and steady-state behavior of the catalysts were evaluated. The kinetic evaluation was complemented by tests in a compact, closed-cycle Hughes CO2 TEA laser operating at a pulse repetition rate of 100 Hz with a catalyst temperature of 75 to 95 C. The Pt/Ce/TiO2 catalyst was compatible with a C(13)O(16)2 gas fill. Author

N90-24594*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

ALTERNATIVE CATALYSTS FOR LOW-TEMPERATURE CO-OXIDATION c25

Steven D. Gardner, Gar B. Hoflund (Florida Univ., Gainesville.), David R. Schryer, Jacqueline Schryer, Billy T. Upchurch, and David R. Brown *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 123-137 (For primary document see N90-24586 18-36)

Avail: NTIS HC A18/MF A03 CSCL 07D

MnO sub x, Ag/MnO sub x, Cu/MnO sub x, Pt/MnO sub x,

Ru/MnO sub x, Au/CeO sub x, and Au/Fe2O3 were synthesized and tested for CO oxidation activity in low concentrations of stoichiometric CO and O2 at 30 to 75 C. Catalytic activity was measured for periods as long as 18000 minutes. At 75 deg Au/MnO sub x is most active sustaining nearly 100 percent CO conversion for 10000 minutes. It also retains high activity at 50 and 30 C with negligible decay in activity. A direct comparison between an unpretreated 10 percent Au/MnO sub x catalyst and an optimized 19.5 percent Pt/SnO sub 2 (pretreated) catalyst shows that the Au/MnO sub x catalyst exhibits much higher catalytic activity and far superior decay characteristics. Other catalysts including Au/CeO sub x and Au/Fe2O3 also perform well. The Cu/MnO sub x exhibits a high initial activity which decays rapidly. After the decay period the activity remains very stable making Cu/MnO sub x a potential candidate for long-term applications such as CO2 lasers in space. Author

N90-24595*# California Univ., San Diego, La Jolla. Chemical Engineering Group.

A COMPUTER PROGRAM FOR THE DESIGN OF OPTIMUM CATALYTIC MONOLITHS FOR CO2 LASERS

K. Guinn, S. Goldblum, E. Noskowski, and R. Herz *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 139-154 (For primary document see N90-24586 18-36)

Avail: NTIS HC A18/MF A03 CSCL 20E

Pulsed CO2 lasers have many applications in aeronautics, space research, weather monitoring and other areas. Full exploitation of the potential of these lasers is hampered by the dissociation of CO2 that occurs during laser operation. The development of closed-cycle CO2 lasers requires active CO-O2 recombination (CO oxidation) catalysts and design methods for implementation of catalysts inside lasers. The performance criteria and constraints involved in the design of catalyst configurations for use in a closed-cycle laser are discussed, and several design studies performed with a computerized design program that was written are presented. Trade-offs between catalyst activity and dimensions, flow channel dimensions, pressure drop, O2 conversion and other variables are discussed. Author

N90-24596*# UOP Ltd., Enfield (England).

MECHANISTIC STUDIES OF THE CO-OXIDATION REACTION ON CATALYSTS FOR USE IN LONG-LIFE CO2 LASERS

Talat Dawood, John R. Richmond, and Brian W. Riley *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 157-180 Sponsored in part by Ministry of Defence, England (For primary document see N90-24586 18-36)

Avail: NTIS HC A18/MF A03 CSCL 20E

The catalytic recombination of carbon monoxide and oxygen was studied under conditions expected to be present in a sealed E-beam CO2 laser system. These conditions are typically a gas inlet temperature of 60 C, a substoichiometric CO/O2 ratio of ca. 2.5/1 with an oxygen feed rate of ca. 5 micromoles/s, a carrier gas comprising He, N2 and CO2 in the ratio of 3:2:1, near atmospheric pressure and a gas velocity of 4 m/s. Heterogeneous catalysts, based on precious metal supported on tin oxide, have been coated onto ceramic monoliths and tested for catalytic activity and stability after a reduction/passivation step. Two catalyst systems have been chosen. These are Pt/Pd/SnO2 and Pt/Ru/SnO2. Under the conditions described above, a characteristic decline in catalytic activity is apparent for both systems, and exit gas temperature has been recognized as a sensitive parameter by which to monitor the activity changes. A semilogarithmic plot of exit temperature as a function of time has revealed two distinct processes connected with the decline in activity: one process is associated with reduction of the oxidized precious metal (at Site A), whilst the other is related to the formation and approach to steady-state of an active site at the metal/support interface (Site B). Author

N90-24597*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

THE EFFECT OF H2O AND PRETREATMENT ON THE ACTIVITY OF A Pt/SnO2 CATALYST **c25**

John D. VanNorman, Kenneth G. Brown, Jacqueline Schryer, David R. Schryer, Billy T. Upchurch, and Barry D. Sidney (Science and Technology Corp., Hampton, VA.) *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 181-191 (For primary document see N90-24586 18-36)

Avail: NTIS HC A18/MF A03 CSCL 07D

CO oxidation catalysts with high activity at 25 C to 100 C are important for long-life, closed-cycle operation of pulsed CO2 lasers. A reductive pretreatment with either CO or H2 has been shown to significantly enhance the activity of a commercially available platinum on tin (IV) oxide (Pt/SnO2) catalyst relative to an oxidative or inert pretreatment or no pretreatment. Pretreatment at temperatures of 175 C and above causes an initial dip in the observed CO2 yield before the steady-state yield is attained. This dip has been found to be caused by dehydration of the catalyst during pretreatment and is readily eliminated by humidifying the catalyst or the reaction gas mixture. It is hypothesized that the effect of humidification is to increase the concentration of OH groups on the catalyst surface which play a role in the reaction mechanism. Author

N90-24598*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

RARE-ISOTOPE AND KINETIC STUDIES OF Pt/SnO2 CATALYSTS **c25**

Billy T. Upchurch, George M. Wood, David R. Schryer, Robert V. Hess, Irvin M. Miller, and Erik J. Kielin (Old Dominion Univ., Norfolk, VA.) *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 193-199 (For primary document see N90-24586 18-36)

Avail: NTIS HC A18/MF A03 CSCL 07D

Closed-cycle pulsed CO2 laser operation requires the use of an efficient CO-O2 recombination catalyst for these dissociation products which otherwise would degrade the laser operation. The catalyst must not only operate at low temperatures but also must operate efficiently for long periods. In the case of the Laser Atmospheric Wind Sounder (LAWS) laser, an operational lifetime of 3 years is required. Additionally, in order to minimize atmospheric absorption and enhance aerosol scatter of laser radiation, the LAWS system will operate at 9.1 micrometers with an oxygen-18 isotope CO2 lasing medium. Consequently, the catalyst must not only operate at low temperatures but must also preserve the isotopic integrity of the rare-isotope composition in the recombination mode. Several years ago an investigation of commercially available and newly synthesized recombination catalysts for use in closed-cycle pulsed common and rare-isotope CO2 lasers was implemented at the NASA Langley Research Center. Since that time, mechanistic efforts utilizing both common and rare oxygen isotopes have been implemented and continue. Rare-isotope studies utilizing commercially available platinum-tin oxide catalyst have demonstrated that the catalyst contributes oxygen-16 to the product carbon dioxide thus rendering it unusable for rare-isotope applications. A technique has been developed for modification of the surface of the common-isotope catalyst to render it usable. Results of kinetic and isotope label studies using plug flow, recycle plug flow, and closed internal recycle plug flow reactor configuration modes are discussed. Author

N90-24599*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

EFFECT OF PRETREATMENT ON A PLATINIZED TIN OXIDE CATALYST USED FOR LOW-TEMPERATURE CO-OXIDATION **c25**

Jean E. Drawdy, Gar B. Hoflund, Steven D. Gardner (Florida Univ., Gainesville.), Eva Yngvadottir, fu386635, and David R. Schryer *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 201-215 (For primary document see N90-24586 18-36)

(Grant NAG1-794)
Avail: NTIS HC A18/MF A03 CSCL 07D

A commercial platinized tin oxide catalyst used for low-temperature CO oxidation has been characterized using ion scattering spectroscopy (ISS), Auger electron spectroscopy (AES) and Electron Spectroscopy for Chemical Analysis (ESCA) before and after reduction in 40 Torr of CO for 1 hour at various temperatures from 75 to 175 C. The reduction results in loss of surface oxygen, formation of metallic tin, conversion of platinum oxides to Pt-O-Sn and Pt(OH)2 and a small amount of metallic Pt which alloys with the tin. These results should be useful in understanding how the pretreatment temperature affects the catalytic activity of platinized tin oxide toward CO oxidation.
Author

N90-24600*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PLATINIZED TIN OXIDE CATALYSTS FOR CO2 LASERS: EFFECTS OF PRETREATMENT
Steven D. Gardner, Gar B. Hoflund (Florida Univ., Gainesville.), David R. Schryer, and Billy T. Upchurch *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 217-229 Previously announced in IAA as A90-31989 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 20E

Platinized tin oxide surfaces used for low-temperature CO oxidation in CO2 lasers have been characterized before and after reduction in CO at 125 and 250 C using ion scattering spectroscopy (ISS) and X ray photoelectron spectroscopy (XPS). XPS indicates that the Pt is present initially as PtO2. Reduction at 125 C converts the PtO2 to Pt(OH)2 while reduction at 250 C converts the PtO2 to metallic Pt. ISS shows that the Pt in the outermost atomic layer of the catalyst is mostly covered by substrate species during the 250 C reduction. Both the ISS and XPS results are consistent with Pt/Sn alloy formation. The surface dehydration and migration of substrate species over surface Pt and Sn appear to explain why a CO pretreatment at 250 C produces inferior CO oxidation activities compared to a 125 C pretreatment.
Author

N90-24601*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CHARACTERIZATION STUDY OF POLYCRYSTALLINE TIN OXIDE SURFACES BEFORE AND AFTER REDUCTION IN CO **c25**
Jean E. Drawdy, Gar B. Hoflund, Mark R. Davidson (Florida Univ., Gainesville.), and David R. Schryer *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 231-250 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

Polycrystalline tin oxide surfaces have been examined before and after reduction in 40 Torr of CO at 100 and 175 C using Auger electron spectroscopy (AES), electron spectroscopy for chemical analysis (ESCA), ion scattering spectroscopy (ISS) and electron stimulated desorption (ESD). The changes in the surface composition and chemical states of the surface species generally are subtle for the reductive conditions used. However, significant changes do occur with regard to the amounts and the chemical forms of the hydrogen-containing species remaining after both the 100 and 175 C reductions.
Author

N90-24602*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ISS AND TPD STUDY OF THE ADSORPTION AND INTERACTION OF CO AND H2 ON POLYCRYSTALLINE Pt **c25**
Orlando Melendez, Gar B. Hoflund (Florida Univ., Gainesville.), and David R. Schryer *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 251-261 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

The adsorption and interaction of CO and H2 on polycrystalline Pt has been studied using ion scattering spectroscopy (ISS) and temperature programmed desorption (TPD). The ISS results indicate that the initial CO adsorption on Pt takes place very rapidly and saturates the Pt surface with coverage close to a monolayer. ISS also shows that the CO molecules adsorb at an angular orientation from the surface normal and perhaps parallel to the surface. A TPD spectrum obtained after coadsorbing C-12 O-16 and C-13 O-18 on Pt shows no isotopic mixing, which is indicative of molecular CO adsorption. TPD spectra obtained after coadsorbing H2 and CO on polycrystalline Pt provides evidence for the formation of a CO-H surface species.
Author

N90-24603*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemical Engineering.
SURFACE DEFECTS AND CHEMISTRY ON THE SnO2(110) SURFACE **c25**
David F. Cox *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 263-275 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

A variety of ultrahigh vacuum (UHV) surface science techniques have been used to characterize the structural, electronic and chemical properties of SnO2(110), a model catalytic surface. Two types of surface oxygen vacancies have been identified, each associated with different band gap (defect) electronic states. Adsorption experiments show that the interaction of simple gases with this surface occurs primarily through these oxygen vacancies and can show site-specificity to only one of the two types of vacancies.
Author

N90-24604*# National Inst. of Standards and Technology, Gaithersburg, MD. Chemical Process Metrology Div.
REVIEW OF MODEL SENSOR STUDIES ON Pd/SnO2(110) SURFACES **c25**
Teresa B. Fryberger and Steve Semancik *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 277-289 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

Studies performed at the National Institute of Standards and Technology on the model gas sensor system, Pd/SnO2(110), are reviewed. Adsorption and interfacial effects play a primary role in the gas sensing process, as they do in catalysis. For this reason, researchers have used a variety of surface sensitive techniques in the research, including x ray and ultraviolet photoelectron spectroscopies (XPS and UPS), low energy electron diffraction (LEED), and ion scattering spectroscopy (ISS). By combining these complementary techniques with in situ gas response (conductance) measurements, researchers were able to correlate directly sensor activity with the composition and structure of the Pd/SnO2 interface. Although the intent of this work is to develop an understanding of gas sensing mechanisms, its relevance to Pt/SnO2 catalytic systems is obvious.
Author

N90-24605*# Brunel Univ., Uxbridge (England). Dept. of Chemistry.
IN SITU ANALYSIS OF CO DURING CHEMISORPTION AND OXIDATION ON GRAPHITE: SUPPORTED Pt BY FTIR-MICROSPECTROMETRY **c25**
Valerie A. Self and Paul A. Sermon *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 291-295 Sponsored in part by Science Research Council (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

For chemisorption and oxidation on Pt/HOPG (highly-orientated pyrolytic) graphite, reflectance Fourier Transform Infrared (FTIR)-microspectrometry reveals a variable state and reactivity for CO. Even for model surface science systems, where surface heterogeneity is minimal, surface diffusion may be too slow relative to the reaction rate to avoid segregation of reactants into surface islands under steady-state conditions. Thus in CO oxidation on Pt (where the relevant surface diffusion coefficients are such that D sub O less than D sub CO) then reactant CO islands exists at

the perimeters of which the surface reaction is thought to occur. Furthermore CO can chemisorb on metals in linear and bridge forms to extents which vary with precise faces predominantly exposed coverage, etc. Infrared has long been used to probe the nature of adsorbed CO on model film and heterogeneous surfaces, but it may now be that FTIR-microspectrometry will allow the state of this adsorbate and reactant to be investigated with a spatial resolution of 4.4 microns on model (and real) catalytic surfaces.
Author

N90-24606*# Brunel Univ., Uxbridge (England). Dept. of Chemistry.
CALORIMETRY, ACTIVITY, AND MICRO-FTIR ANALYSIS OF CO CHEMISORPTION, TITRATION, AND OXIDATION ON SUPPORTED Pt **c25**
Paul A. Sermon, Valerie A. Self, Mariana S. W. Vong, and Alpha T. Wurie *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 297-307 Sponsored in part by Science Reseach Council and rch Council and Johnson Matheny Chemicals Ltd., London, England (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

The value of in situ analysis on CO chemisorption, titration and oxidation over supported Pt catalysts using calorimetry, catalytic and micro-FTIR methods is illustrated using silica- and titania-supported samples. Isothermal CO-O and O2-CO titrations have not been widely used on metal surfaces and may be complicated if some oxide supports are reduced by CO titrant. However, they can illuminate the kinetics of CO oxidation on metal/oxide catalysts since during such titrations all O and CO coverages are scanned as a function of time. There are clear advantages in following the rates of the catalyzed CO oxidation via calorimetry and gc-ms simultaneously. At lower temperatures the evidence they provide is complementary. CO oxidation and its catalysis of CO oxidation have been extensively studied with hysteresis and oscillations apparent, and the present results suggest the benefits of a combined approach. Silica support porosity may be important in defining activity-temperature hysteresis. FTIR microspectroscopy reveals the chemical heterogeneity of the catalytic surfaces used; it is interesting that the evidence with regard to the dominant CO surface species and their reactivities with regard to surface oxygen for present oxide-supported Pt are different from those seen on graphite-supported Pt.
Author

N90-24607*# Brunel Univ., Uxbridge (England). Dept. of Chemistry.
ANALYSIS OF Pt/SnO(SUB x) DURING CATALYSIS OF CO OXIDATION **c25**
Paul A. Sermon, Valerie A. Self, and E. P. S. Barrett *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 309-312 Sponsored in part by Science Research Council (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

Temperature-programmed reduction using 6kPaH2 suggests that a sample consisting of 3 percent Pt supported directly on SnO2 is, under conditions of catalysis of CO oxidation used here, best represented as 3 percent Pt/SnO sub x, since the support is likely to partially reduced, probably in the vicinity of the metal/oxide interface. Catalytic measurements at 421 to 424 K show that this 3 percent Pt/SnO sub x is significantly more active per unit area of Pt than 6 percent Pt/SiO2 in catalyzing the oxidation of CO. In situ micro-FTIR reveals that while the latter has predominantly linearly bound CO on the surface under reaction conditions, the Pt/SnO sub x also has a species absorbing at 2168 cm(exp -1) which may be CO upon Pt in a positive oxidation state or weakly chemisorbed CO on zero-valent Pt. This may be directly involved in the low temperature oxidation of CO on the Pt/SnO sub x, since being weakly held the activation energy for its surface diffusion to the metal/oxide interface will be low; such mobile species could allow the high rates of surface transport and an increase in the fraction of the surface over which the CO oxidation occurs. FTIR also reveals carbonate-type species on the P/SnO sub c surface.
Author

N90-24608*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CHARACTERIZATION OF THE SURFACES OF PLATINUM/TIN OXIDE BASED CATALYSTS BY FOURIER TRANSFORM INFRARED SPECTROSCOPY (FTIR) **c25**
Joseph T. Keiser and Billy T. Upchurch *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 313-320 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

A Pt/SnO2 catalyst has been developed at NASA Langley that is effective for the oxidation of CO at room temperature (1). A mechanism has been proposed to explain the effectiveness of this catalyst (2), but most of the species involved in this mechanism have not been observed under actual catalytic conditions. A number of these species are potentially detectable by Fourier Transform Infrared Spectroscopy (FTIR), e.g., HOSnO sub x, HO sub y PtO sub z, Pt-CO, and SnHCO3. Therefore a preliminary investigation was conducted to determine what might be learned about this particular catalyst by transmission FTIR. The main advantage of FTIR for this work is that the catalyst can be examined under conditions similar to the actual catalytic conditions. This can be of critical importance since some surface species may exist only when the reaction gases are present. Another advantage of the infrared approach is that since vibrations are probed, subtle chemical details may be obtained. The main disadvantage of this approach is that FTIR is not nearly as sensitive as the Ultra High Vacuum (UHV) surface analytical techniques such as Auger, Electron Spectroscopy for Chemical Analysis (ESCA), Electron Energy Loss Spectroscopy (EELS), etc. Another problem is that the assignment of the observed infrared bands may be difficult.
Author

N90-24609*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CHEMISORPTION STUDIES OF Pt/SnO2 CATALYSTS **c25**
Kenneth G. Brown, Susan K. Ohorodnik, John D. VanNorman, Jacqueline Schryer (Old Dominion Univ., Norfolk, VA.), Billy T. Upchurch, and David R. Schryer *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 321-335 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

The low temperature CO oxidation catalysts that are being developed and tested at NASA-Langley are fairly unique in their ability to efficiently oxidize CO at low temperatures (approx. 303 K). The bulk of the reaction data that has been collected in the laboratory has been determined using plug flow reactors with a low mass of Pt/SnO2/SiO2 catalyst (approx. 0.1 g) and a modest flow rate (5 to 10 sc sm). The researchers have previously characterized the surface solely in terms of N2 BET surface areas. These surface areas have not been that indicative of reaction rate. Indeed, some of the formulations with high BET surface area have yielded lower reaction rates than those with lower BET surface areas. As a result researchers began a program of determining the chemisorption of the various species involved in the reaction; CO, O2 and CO2. Such a determination of will lead to a better understanding of the mechanism and overall kinetics of the reaction. The pulsed-reactor technique, initially described by Freel, is used to determine the amount of a particular molecule that is adsorbed on the catalyst. Since there is some reaction of CO with the surface to produce CO2, the pulsed reactor had to be coupled with a gas chromatograph in order to distinguish between the loss of CO that is due to adsorption by the surface and the loss that is due to reaction with the surface.
Author

N90-24610*# Royal Signals and Radar Establishment, Malvern (England).
DISSOCIATION PHENOMENA IN ELECTRON-BEAM SUSTAINED CARBON DIOXIDE LASERS
Michael R. Harris and David V. Willetts *In* NASA, Langley

Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 339-358 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 20E

A number of applications are emerging requiring efficient, long pulse, long-life sealed CO2 lasers. Examples include the proposed NASA and ESA wind lidars. Electron-beam sustained discharge devices are strong contenders. Unlike self-sustained discharges, e-beam sustenance readily provides efficient performance from large volume discharges and offers pulse lengths well in excess of the microsecond or so generally associated with self-sustained devices. In the case of the e-beam sustained laser, since the plasma is externally maintained and operated at electric field strengths less than that associated with the glow to arc transition, the discharges can be run even in the presence of strongly attacking species such as O2. Build up of large levels of attacking contaminants is nevertheless undesirable as their presence reduces the current drawn by the plasma and thus the pumping rate to the upper laser level. The impedance rise leads to a mismatch of the pulse forming network with a consequent loss of control over energy deposition, operating E/N, and gain. Clearly CO2 dissociation rates, the influence of dissociation products on the discharge and gain, and tolerance of the discharge to these products need to be determined. This information can then be used to assess co-oxidation catalyst requirements for sealed operation. Author

N90-24611*# Marconi Avionics Ltd., Borehamwood (England). Applied Physics Div.
THE e-BEAM SUSTAINED CO2 LASER AMPLIFIER
M. J. Brown, S. R. Shaw, M. H. Evans, I. M. Smith, and W. Holman *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 359-368 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 20E

The design features of an e-beam sustained CO2 amplifier are described. The amplifier is designed specifically as a catalyst test-bed to study the performance of room temperature precious metal CO-oxidation catalysts under e-beam sustained operation. The amplifier has been designed to provide pulse durations of 30 microseconds in a discharge volume of 2 litres. With a gas flow velocity of 2 metres per second, operation at repetition rates of 10 Hz is accommodated. The system is designed for sealed-off operation and a catalyst bed is housed in the gas circulation system downstream from the discharge region. CO and oxygen monitors are used for diagnosis of gas composition in the amplifier so that catalyst performance can be monitored in situ during sealed lifetests. Author

N90-24612*# Marconi Avionics Ltd., Borehamwood (England). Applied Physics Div.
A COMPACT, RUGGED, HIGH REPETITION RATE CO2 LASER INCORPORATING CATALYST
P. M. Schwarzenberger and X. Matzangou *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 369-378 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 20E

The principal design features and operating characteristics of a high repetition rate CO2 laser are outlined. The laser is a compact, rugged unit, completely sealed and incorporating an unheated solid catalyst. Stable operation has been successfully demonstrated over a temperature range of -35 C to 65 C. Author

N90-24613*# Spectra Technology, Inc., Bellevue, WA.
PERFORMANCE OF ALUMINA-SUPPORTED Pt CATALYSTS IN AN ELECTRON-BEAM-SUSTAINED CO2 LASER AMPLIFIER
D. L. Cunningham, P. L. Jones, C. I. Miyake, and S. E. Moody *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 379-382 (For primary document see N90-24586 18-36)
(Contract MIT-BX-2332)
Avail: NTIS HC A18/MF A03 CSCL 20E

The performance of an alumina-supported Pt catalyst system used to maintain the gas purity in an electron-beam-sustained (636) isotope CO2 laser amplifier has been tested. The system characteristics using the two-zone, parallel flow reactor were determined for both continuous- and end-of-day reactor operation using on-line mass spectrometric sampling. The laser amplifier was run with an energy loading of typically 110 J-l/atm and an electron-beam current of 4 mA/sq cm. With these conditions and a pulse repetition frequency of 10 Hz for up to 10,000 shots, increases on the order of 100 ppm O2 were observed with the purifier on and 150 ppm with it off. The 1/e time recovery time was found to be approximately 75 minutes. Author

N90-24614*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MONITORING OF CATALYST PERFORMANCE IN CO2 LASERS USING FREQUENCY MODULATION SPECTROSCOPY WITH DIODE LASERS
Liang-Guo Wang (College of William and Mary, Williamsburg, VA.) and Glen Sachse *In its* Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 383-386 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 20E

Closed-cycle CO2 laser operation with removal of O2 and regeneration of CO2 can be achieved by catalytic CO-O2 recombination. Both parametric studies of the optimum catalyst formulation and long-term performance tests require on line monitoring of CO, O2 and CO2 concentrations. There are several existing methods for molecular oxygen detection. These methods are either intrusive (such as electrochemical method or mass spectrometry) or very expensive (such as CARS, UV laser absorption). Researchers demonstrated a high-sensitivity spectroscopic measurement of O2 using the two-tone frequency modulation spectroscopy (FMS) technique with a near infrared GaAlAs diode laser. Besides its inexpensive cost, fast response time, nonintrusive measurements and high sensitivity, this technique may also be used to differentiate between isotopes due to its high spectroscopic resolution. This frequency modulation spectroscopy technique could also be applied for the on-line monitoring of CO and CO2 using InGaAsP diode lasers operation in the 1.55 microns region and H2O in the 1.3 microns region. The existence of single mode optical fibers at the near infrared region makes it possible to combine FMS with optical fiber technology. Optical fiber FMS is particularly suitable for making point-measurements at one or more locations in the CO2 laser/catalyst system. Author

N90-24615*# UOP Ltd., Enfield (England).
APPLICATIONS OF LOW TEMPERATURE CO-OXIDATION CATALYSTS TO BREATHABLE GASES **c25**
Ehsan Noordally and John R. Richmond *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 387-402 (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

Modifications of tin oxide/precious metal catalysts described for use in CO2 lasers have also been developed for use in other applications; namely, as low temperature CO oxidation components in fire escape hoods/masks for mines, aircrafts, hotels, and offices and in sealed environments, such as hyperbaric chambers and submarines. Tin oxide/precious metal catalysts have been prepared on a variety of high surface area cloth substrates for application in fire escape hoods. These show high and stable CO oxidation capability (10 to the 4th power ppm CO reduced to 10 to the 1st power ppm CO) at GHSV of 37,000 h(-1) with water saturated inlet gas at body heat (37 C) and below. Water vapor plays an important role in the surface state/performance of tin oxide catalyst. Water-resistant formulations have been produced by the introduction of transition metal promoters. Tin oxide/precious metal catalysts have also been developed for CO oxidation in the North Sea diving environment. These are currently in use in a variety of hyperbaric chambers and diving vehicles. Ambient temperature operation and resistance to atmospheric water vapor have been

demonstrated, and as a result, they offer a viable alternative to hopcalite or heated catalyst systems. A new range of non-tin oxide based low temperature CO oxidation catalysts is described. They are based on reducible metal oxides promoted with previous metals. Preliminary data on selected materials in the form of both cloth artifacts and shaped pellets are presented. They are expected to be applicable both to the breathable gas application area and to CO2 lasers. Author

N90-24616*# Artech Associates, East Haven, CT.
POTENTIAL TECHNOLOGY TRANSFERS OF RESEARCH ON LOW-TEMPERATURE CARBON MONOXIDE-OXYGEN RECOMBINATION CATALYSTS **c25**
Edward J. Poziomek *In* NASA, Langley Research Center, Low-Temperature CO-Oxidation Catalysts for Long-Life CO2 Lasers Jun. 1990 p 403-409 Sponsored in part by American Association for the Advancement of Science, Washington, DC and EPA, Washington, DC (For primary document see N90-24586 18-36)
Avail: NTIS HC A18/MF A03 CSCL 07D

Results from research on catalytic recombination of CO-O2 for stable closed-cycle operation of CO2 lasers hold much promise for a variety of technology transfer. Expansion of CO2 laser remote sensing applications toward chemical detection and pollution monitoring would certainly be expected. However, the catalysts themselves may be especially effective in low-temperature oxidation of a number of chemicals in addition to CO. It is therefore of interest to compare the CO-O2 catalysts with chemical systems designed for chemical sensing, air purification and process catalysis. Success in understanding the catalytic mechanisms of the recombination of CO-O2 could help to shed light on how catalyst systems operate. New directions in low-temperature oxidation catalysts, coatings for chemical sensors and sorbents for air purification could well emerge. Author

N90-24617# Aerospace Corp., El Segundo, CA. Electronics Research Lab.
HIGH-ORDER MODE DEPENDENCIES IN GAIN-GUIDED TWIN-STRIPE LASER DIODE ARRAYS
Donald G. Heflinger, Michael B. Chang, and Wayne R. Fenner 27 Feb. 1990 38 p
(Contract F04701-88-C-0089)
(AD-A220868; TR-0088(3925-04)-3; SSD-TR-90-10) Avail: NTIS HC A03/MF A01 CSCL 20/3

Experimental data and modeling are presented which show that under appropriate conditions a set of index guided modes can exist and have lower thresholds than gain-guided supermodes for twin stripe semiconductor lasers. It is also shown that more than the two modes predicted by supermode theory can simultaneously lase. The near field and far field profiles of the index guided modes are shown to have a narrower extent than those predicted by supermode theory and, in the case of the fundamental mode, be single lobed. GRA

N90-24618# Oak Ridge National Lab., TN. Engineering Physics and Mathematics Div.
LASER RANGE CAMERA MODELING
Kai Storjohann Apr. 1990 13 p
(Contract DE-AC05-84OR-21400)
(DE90-008220; ORNL/TM-11530) Avail: NTIS HC A03/MF A01

An imaging model is described that was derived for use with a laser range camera (LRC) developed by the Advanced Intelligent Machines Division of Odetics. However, this model could be applied to any comparable imaging system. Both the derivation of the model and the determination of the LRC's intrinsic parameters are explained. For the purpose of evaluating the LRC's imaging model into a standard camera's (SC) pinhole model is derived. By virtue of this transformation, the evaluation of the LRC's external orientation can be found by applying any SC calibration technique. DOE

N90-24619# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
MIT (MASSACHUSETTS INSTITUTE OF TECHNOLOGY) SHORT-WAVELENGTH LASER PROJECT Progress Report, 15 May 1989 - 1 Jan. 1990
Peter Hagelstein, Santanu Basu, Martin Muendel, Sumanth Kaushik, John Paul Braud, Dan Tauber, and Rolf A. Wyss 1990 99 p
(Contract DE-FG02-89ER-14012)
(DE90-008975; DOE/ER-14012/1) Avail: NTIS HC A05/MF A01

We review the status of the short wavelength laser project at MIT. At this point we are on schedule relative to our initial proposal: the power amplifier is under construction at LLNL, the vacuum chamber has been designed, and development of the alignment system is underway. We report progress on the design of whisper gallery mirror EUV laser cavities, and have proposed a new scheme for frequency mixing in the EUV. We anticipate our first laser plasma experiment late spring or early summer of 1990. DOE

N90-24620# Texas Univ. at Dallas, Richardson. Center for Quantum Electronics.
PROOF OF THE FEASIBILITY OF COHERENT AND INCOHERENT SCHEMES FOR PUMPING A GAMMA-RAY LASER Final Technical Report, 26 Sep. 1986 - 24 Dec. 1989
Carl B. Collins Mar. 1990 196 p
(Contract N00014-86-C-2488)
(AD-A219972; UTD-GRL/8903) Avail: NTIS HC A09/MF A02 CSCL 09/3

Papers presented include: Thermal Economy of a Gamma-Ray Laser; Photoexcitation of Nuclear Isomers by (Gamma, Gamma') Reactions; Adaptation of a Fixed Energy Electron Accelerator to Produce Variable Endpoint Bremsstrahlung; Determination of Gateway States in 197Au with a Compton X Ray Spectrometer; Calibration of Pulsed Bremsstrahlung Spectra with Photonuclear Reactions of 77Se and 79Br; Scaling to High Average Powers of a Flash X Ray Source Producing Nanosecond Pulses; Frequency Modulation Spectrometer for Mossbauer Studies; Calibration of Pulsed X Ray Spectra; Depopulation of the Isomeric State 180Ta(m) by the Reaction 180Ta(m) (Gamma, Gamma') 180Ta; Diamond-like Carbon Films Prepared with a Laser Ion Source; Activation of 115In(m) by Single Pulses of Intense Bremsstrahlung; Flash X Ray Source Excited by Stacked Blumlein Generators; Activation of 111 Cd(m) by Single Pulses of Intense Bremsstrahlung; Comment on Mossbauer Sidebands from a Single Parent Line; Large Scale Effects of the Magnetic Phase Modulation of Recoilles Gamma Transitions; Laser Plasma Source of Amorphic Diamond; Mossbauer Isomer Shift Measurements without Mechanical Tuning; and Accelerated Decay of 180Ta(m) and 176Lu in Stellar Interiors through (Gamma, Gamma') Reactions. GRA

N90-24621# Stanford Univ., CA. Physics Lab.
RESEARCH STUDIES ON EXTREME ULTRAVIOLET AND SOFT X RAY LASERS Annual Report, 1 Sep. 1988 - 31 Aug. 1989
S. E. Harris and J. F. Young 28 Mar. 1990 17 p Sponsored in cooperation with Army Research Office
(Contract F49620-88-C-0120)
(AD-A220271; ARO-26160.9-PH) Avail: NTIS HC A03/MF A01 CSCL 09/3

The overall purpose of this program has been to study the physics, technology, and spectroscopy of extreme ultraviolet (XUV) and soft x ray lasers. The objective of the work was to develop a class of fixed frequency and tunable lasers whose wavelengths span the 100 A to 1000 A spectral region. Of special interest was developing incoherent, laser driven, harder x ray sources that operate on a femtosecond time scale, and which could be used both for time resolved x ray spectroscopy and, ultimately, for the pumping of solid state, micron dimension, x ray lasers. Work on XUV and soft x ray lasers began about ten years ago with the use of high peak power microwaves to produce metastable, non-autoionizing core-excited species. The work has proceeded on both the spectroscopic and the laser fronts. Section 2 lists the principal accomplishments in these areas. GRA

N90-24622*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CO OXIDATION CATALYSTS FOR LONG-LIFE CO2 LASERS
David R. Schryer, comp. Oct. 1989 117 p
(NASA-CP-10037; NAS 1.55:10037) Avail: NTIS HC A06/MF A01 CSCL 20E

This publication presents a collection of papers and extended abstracts of papers submitted for presentation at the International Conference on CO Oxidation Catalysts for Long-Life CO2 Lasers. The papers encompass a wide range of topics related to the development and testing of low-temperature, high-efficiency CO-oxidation catalysts with primary emphasis on their applicability to long-life, closed-cycle CO2 lasers. Author

N90-24623# Research Inst. of National Defence, Stockholm (Sweden). Dept. of Weapons Technology.
NONLINEAR INTERACTION BETWEEN LASER RADIATION AND AEROSOLS
Mats Flaum and Olof Rydlund Oct. 1989 41 p In SWEDISH; ENGLISH summary
(FOA-C-20768-2.3; ISSN-0347-3694; ETN-90-96581) Avail: NTIS HC A03/MF A01

The status of an experimental project to study the dynamics of nonlinear interaction of an aerosol and a continuous carbon dioxide laser beam with power density in the interval 100 to 10,000 W per sq cm, is descibed. As background, the importance of this class of interaction for high power laser beam transmission through the atmosphere is illustrated. The experimental arrangement is described in detail. Preliminary observations and experiences are discussed. The radar induced shadow on the aerosol is called extinction. By using a two wavelength helium-neon laser, simultaneously at wavelength 632.8 nm and 9.3 micrometers, it is possible to obtain, in principle, enough information for determining size of particles and the aerosol density. ESA

N90-24624# Research Inst. of National Defence, Linkoeping (Sweden). Dept. of Information Technology.
GAIN IN WAVEGUIDE LASER AT 10.6 MICROMETER
Anders Callenaas and Ingmar Renhorn Oct. 1989 24 p In SWEDISH; ENGLISH summary
(FOA-C-30540-3.1; ISSN-0347-3708; ETN-90-96583) Avail: NTIS HC A03/MF A01; Research Inst. of National Defence, Box 1165, S-581 11 Linkoeping, Sweden, 50 Swedish crowns

The installation described is limited to the amplification of small data. The measurements were done with different gas mixtures at pressures 25 to 400 torr. The maximum amplification was reached with the mixture 15:3:2 (He:CO2:N2) at 100 torr. The waveguide had an inner diameter of 2 mm and an outer diameter of 4 mm, its length was 16 cm. The waveguide must be cooled down during the amplification operation. In this case aluminum oxide has a sufficient conductive heat transfer, so it is unnecessary to have a better thermal conductor such as BeO. ESA

N90-24625# Ecole Nationale Superieure des Telecommunications, Paris (France). Lab. d'Optoelectronique.
EVOLUTION EQUATION SIMULATION OF SEMICONDUCTOR LASERS UNDER A PULSED REGIME [SIMULATION DES EQUATIONS D'EVOLUTION DES LASERS SEMICONDUCTEURS EN REGIME IMPULSIONNEL]
Nathan Gomes Oct. 1989 49 p In FRENCH Sponsored by CNRS and the Royal Society
(Telecom-Paris-89-D-010; ISSN-0751-1345; ETN-90-96954)
Avail: NTIS HC A03/MF A01

A type evolution equation including a phase evolution equation allowing for the description of spectral properties is described. A simple expression for nonlinear compression of gain is studied. Applications of the equation to the study of impulse modulation in semiconductor lasers are described. Simulations carried out point out the importance of power and modulation in obtaining very fine impulses. The validity of the model is determined by comparison of actual experimental values and simulation results for a given laser. Difficulties are found in trying to find simultaneous agreement between temporal and spectral measurements. This is concluded to be due to a nonlinear mechanism more complex than the model used is prepared to deal with. ESA

N90-24626# Environmental Research Inst. of Michigan, Ann Arbor. Advanced Concepts Div.
ANALYSIS OF PHASE RETRIEVAL IN ACTIVE IMAGING Final Technical Report, 1 Aug. 1986 - 7 Nov. 1988
J. R. Fienup Feb. 1990 178 p
(Contract F33615-83-C-1046)
(AD-A221080; ERIM-167400-133-F; WRDC-TR-89-1150) Avail: NTIS HC A09/MF A01 CSCL 14/4

This report describes a collection of research tasks which develop techniques to reconstruct fine-resolution images of satellites coherently illuminated by lasers. Two major imaging modes were developed. In the first, called imaging correlography, an incoherent image of the coherently illuminating target is reconstructed from multiple realizations of the intensity of the nonimaged (aperature-plane) laser speckle pattern backscattered from the target. In the second mode, a coherent image of the target is reconstructed from a single realization of the nonimaged laser speckle pattern. In the latter mode, reconstruction methods were developed for the case which contains a strong glint (or glints) and for the case in which one has partial information about the phase of the optical field backscattered by the target. GRA

N90-24627# Air Force Weapons Lab., Kirtland AFB, NM.
PHASE LOCKING OF TWO HIQ RESONATORS Final Report, Sep. 1985 - Mar. 1990
R. A. Riviere, C. A. Huguley, S. C. Holswade, and C. M. Clayton Mar. 1990 .33 p
(AF Proj. 3326)
(AD-A221123; WL-TR-89-96) Avail: NTIS HC A03/MF A01 CSCL 09/3

The experimental results of phase locking two confocal unstable resonators with 90 beam rotation (UR90 or HiQ) are presented. The two resonators used separate gain cells located in different rooms. The lasers were conventionally coupled by passing a portion of the reverse wave from each laser through a hole in the wall and injecting it into other laser's forward wave. The roles of self-feedback and alignment sensitivity in phase-locking are examined. GRA

N90-24628# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
MODELS OF INTRACAVITY FREQUENCY DOUBLED LASERS Ph.D. Thesis - Georgia Inst. of Technology.
Glenn Edward James 1990 328 p
(AD-A221182; AFIT/CI/CIA-90-007D) Avail: NTIS HC A15/MF A02 CSCL 09/3

In many laser applications, the frequency of light produced by the laser is doubled by a crystal with nonlinear optical properties. The presence of such a crystal inside a laser cavity can produce large, irregular fluctuations in the output intensity. This thesis examines nonlinear systems of ordinary differential equations for the longitudinal mode intensities (physical observables) and gains of intracavity doubled lasers. A new system of equations is derived which models the frequency doubling of a general class-B laser with any number of intracavity birefringent elements, and the relevant features of the cavity configuration are reduced to two parameters. The complete range of behavior of the intensity output is characterized for one, two and three longitudinal modes in this general framework. A novel approach to the linearized stability analysis of the model leads to explicit stability criteria for the cavity parameters, and to several successful predictions of ways to stabilize the laser output. Several experimental laser configurations previously studied prove to be special cases of the general model; all the experimental results confirm the correspondence between the theory and experiment. In the specific case of an intracavity doubled Nd:YAG laser, numerical results trace an intermittency route to chaos, with cross saturation as the control parameter. Samples of experimental output are closely matched by numerical integrations. GRA

N90-24629# Oregon State Univ., Corvallis. Dept. of Mechanical Engineering.
DURIP: SPONTANEOUS RAMAN SYSTEM FOR THE STUDY OF ENHANCED COMBUSTION AND NON-THERMAL PLASMAS Final Technical Report, 1 Dec. 1988 - 30 Nov. 1990
Richard B. Peterson 26 Feb. 1990 6 p
(Grant AF-AFOSR-0093-89; AF Proj. 3842)
(AD-A221410; AFOSR-90-0467TR) Avail: NTIS HC A02/MF A01 CSCL 20/5

The instrumentation purchased on the DURIP grant and the research work that this instrumentation will support is described. The objective of the grant was to acquire elements of a spontaneous Raman system for gas phase diagnostic work on currently funded combustion studies. Toward this end, a neodymium: YAG pulsed laser was acquired with frequency doubling, an optical multichannel analyzer (OMA), a computer system required to operate the OMA, and a flat flame burner for validation and testing of the Raman set-up. GRA

N90-24630# Israel Atomic Energy Commission, Beersheba. Nuclear Research Center.
THE ELECTRICAL CHARACTERISTIC AND GAIN BEHAVIOR AS A FUNCTION OF THE RADIAL DISTANCE FROM THE LASER AXIS IN A COPPER VAPOR LASER Ph.D. Thesis
G. Gal Jun. 1989 67 p Prepared in cooperation with Ben-Gurion Univ. of the Negev, Beersheba (Israel)
(DE90-615371; NRCN-598) Avail: NTIS (US Sales Only) HC A04/MF A01

The dependence of few parameters (related to the laser gain) on the radial distance from the laser axis, is observed very easily in a large-bore Copper Vapor Laser (CVL). An 80-mm-bore CVL which has reproducible parameters for research purposes has been constructed. The temporal development of the gain at different radial distances in this laser has been measured. A narrow probing beam from a small CVL operating as a oscillator has been used for the measurements, while the large-bore CVL has been operated as an amplifier and probed by this beam at different radial points. The electric response of the laser has also been checked and lead to the conclusion that raising the electrons energy in the laser plasma entails higher gain. As the laser tube wall was moved towards the laser axis, a temporal lag in the gain development and a reduction in its size has been found. The temporal lag is related to skin effect which delays the penetration of the electric field in the plasma towards the laser axis. The reduction in gain is related to the radial dependence of the population of the laser lower levels. It has also been found that under saturation the average power per unit area extracted from the laser is weakly dependent on the radial distance. DOE

N90-25045*# Eureka Coll., IL. Dept. of Mathematics and Physics.
STABILITY OF LASER OSCILLATOR SYSTEMS
Joseph C. Hafele *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 74-75 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20E

N90-25047*# Virginia State Univ., Petersburg. Dept. of Physics.
CHARACTERIZATION OF A Ho:Tm:Cr:YAG LASER WITH A Cr:GSAG LASER AS PUMPING SOURCE Abstract Only
George W. Henderson *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 77-78 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20E

N90-25063*# College of Southern Georgia, Statesboro. Dept. of Mathematics and Computer Science.
AN INVESTIGATION OF A MATHEMATICAL MODEL OF AN OPTICALLY PUMPED Ti(3+):Al2O3 LASER SYSTEM Abstract Only
Lila F. Roberts *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 133-134 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 09B

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N90-24631 Case Western Reserve Univ., Cleveland, OH.
THE EXPERIMENTAL EVALUATION AND APPLICATION OF HIGH TEMPERATURE SOLID LUBRICANTS Ph.D. Thesis
Christopher DellaCorte 1989 133 p
Avail: Univ. Microfilms Order No. DA9004460

A research program meant to develop an understanding of high temperature solid lubrication and experimental techniques through the development of a composite lubricant coating system was described. The knowledge gained through this research was then applied to a specific engineering challenge, the tribology of a sliding seal for hypersonic flight vehicles. The solid lubricant coating is a chromium carbide based composite combined with silver, which acts as a low temperature lubricant, and barium fluoride/calcium fluoride eutectic, which acts as a high temperature lubricant. This composite coating provides good wear resistance and low friction for sliding contacts from room temperature to over 900 C in reducing or oxidative environments. The specific research on this coating included a composition screening using a foil gas bearing test rig and the use of thin silver films to reduce initial wear using a pin-on-disk test rig. The chemical stability of the materials used was also addressed. This research indicated that soft metallic films and materials which become soft at elevated temperatures are potentially good lubricants. The general results from the experiments with the model solid lubricant coating were then applied to a sliding seal design concept. This seal design requires that a braided ceramic fabric slide against a variety of metal counterface materials at temperatures from 25 to 850 C in an oxidative environment. A pin-on-disk tribometer was used to evaluate the tribological properties of these materials and to develop lubrication techniques. The results indicate that these materials must be lubricated to prevent wear and reduce friction. Thin films of silver, gold and calcium fluoride provided lubrication to the sliding materials. The data obtained and the lubrication techniques developed provide important information to designers of sliding seals. Dissert. Abstr.

N90-24632# Argonne National Lab., IL. Materials and Components Technology Div.
EFFECT OF FILM ADHESION ON TRIBOLOGICAL PROPERTIES OF SILVER-COATED ALUMINA
R. A. Erck, A. Erdemir, and G. R. Fenske Feb. 1990 16 p Presented at the 8th International Triennial Conference on Thin Films and the 17th International Conference on Metallurgical Coatings, San Diego, CA, 1-6 Apr. 1990
(Contract W-31-109-eng-38)
(DE90-010090; CONF-900419-5) Avail: NTIS HC A03/MF A01

Soft metal films are seen as possible solid lubricants for sliding ceramics in high-temperature environments. Ion bombardment of substrate and film can improve film adhesion and tribological properties of metal films deposited on ceramics. To provide a more detailed understanding of the relationship between measured adhesion strength, surface roughness, and wear performance of coatings, thin Ag films were vapor-deposited on smooth and roughened alumina substrates using 1-keV ion bombardment before and during deposition. A pull-type tester was used to measure the adhesion of films to the substrate. A ball-on-flat test machine was used to evaluate the wear of an uncoated alumina ball sliding on silver-coated substrates. Measurements of film adhesion and sliding wear, and an scanning electron microscope (SEM) examination of wear tracks, are reported. Ball wear on roughened surfaces was reduced by a factor of approximately 3 for poorly adhering coatings,

but by a factor of approximately 130 for well-adhering coatings deposited after argon/oxygen sputter-cleaning, compared to bare Al2 O3. For films with the lowest wear, the Ag coating wore off the tips of the asperities, but the film remained almost completely intact. For smooth flats, wear reductions by a factor of approximately 3 were obtained for well-adherent coatings. DOE

N90-24633*# Texas Univ., Austin. Dept. of Mechanical Engineering.
DESIGN OF AN AUTONOMOUS TELEOPERATED CARGO TRANSPORTING VEHICLE FOR LUNAR BASE OPERATIONS
James Holt, Tom Lao, and Nkoy Monali 1989 97 p
(Contract NASw-4435)
(NASA-CR-186686; NAS 1.26:186686) Avail: NTIS HC A05/MF A01 CSCL 13I

At the turn of the century NASA plans to begin construction of a lunar base. The base will likely consist of developed areas (i.e., habitation, laboratory, landing and launching sites, power plant) separated from each other due to safety considerations. The Self-Repositioning Track Vehicle (SRTV) was designed to transport cargo between these base facilities. The SRTV operates by using two robotic arms to raise and position segments of track upon which the vehicle travels. The SRTV utilizes the semiautonomous mobility (SAM) method of teleoperation; actuator-controlled interlocking track sections; two robotic arms each with five degrees of freedom; and these materials: titanium for structural members and aluminum for shell members, with the possible use of light-weight, high-strength composites. Author

N90-24634# Universitaet der Bundeswehr, Hamburg (Germany, F.R.). Fachbereich Maschinenbau.
SENSOR SYSTEM FOR AUTOMATIC TRAFFIC RECORDING IN FREE AREA Ph.D. Thesis [SENSORSYSTEM ZUR AUTOMATISCHEN VERKEHRSERFASSUNG IN FREIEN GELAENDE]
Hermann Grosch 1989 181 p In GERMAN
(ETN-90-96493) Avail: NTIS HC A09/MF A01

A concept for the realization of an intelligent, modular ground sensor system, which works with passive sensors and adapts automatically to the environment, the weather and the traffic variations is described. The properties of the different transmission channels were investigated: air-acoustic channel (signal by divergence and adsorption) ground-acoustic channel (transfer function, signal spectra) magnetic channel (elliptic and spheric symmetric field, parasitics). For the technical realization, the acoustic sensors and the magnetic field sondes are integrated in a module. ESA

N90-24635# Los Alamos National Lab., NM.
TRIBOLOGICAL AND MECHANICAL PROPERTIES OF Fe/Ti MULTILAYERED FILMS
Michael Nastasi, Juha-Pekka Hirvonen, Thomas R. Jervis, and S. N. Basu 1990 10 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990 Sponsored in part by AFWAL
(Contract W-7405-eng-36)
(DE90-011949; LA-UR-90-1524; CONF-900466-49) Avail: NTIS HC A02/MF A01

A 900 A as-deposited multilayered structure of alternating Fe and Ti on hardened tool steel has been examined for tribological and mechanical properties. The multilayer in contact with a 521000 steel ball counter surface possessed a 0.16 friction coefficient and showed good wear character after 1000 cycles in pin-on-disk experiments. Nanoindentation experiments show a 20 percent increase in hardness for material in the wear track. Electron microscopy shows that the as-deposited bcc-Fe plus hcp-Ti multilayer composite transforms to a nanocrystalline alloy plus bcc-Fe by solid state reaction during pin-on-disk friction and wear tests. The low friction observed in these surface films is attributed to the formation of a hard nanocrystalline alloy and improved interlayer and film/substrate adhesion which result during solid state reaction. DOE

N90-24285*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ROBOTICS PROGRAM AT THE NASA GODDARD SPACE FLIGHT CENTER
Stanford Oliendorf *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 13-21 (For primary document see N90-24280 18-12)
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N90-24289# National Space Development Agency, Ibaraki (Japan). Tsukuba Space Center.
ADVANCED ROBOTICS FOR THE ON-ORBIT SERVICING
Mitsushige Oda *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 47-50 (For primary document see N90-24280 18-12)
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N90-24291# Italian Space Agency, Rome.
THE SPIDER ROBOTIC SYSTEM
Simonetta DiPippo, P. G. Magnani, Walter Prendin, and Antonio Terribile (Tecnomare S.p.A., Italy) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 57-62 (For primary document see N90-24280 18-12)
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N90-24315# Singer-Link-Miles Ltd., Lancing (England).
ROBOTIC SIMULATION SUPPORT TO SYSTEMS DEVELOPMENT
R. M. Daintree and G. K. Speed *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 281-287 (For primary document see N90-24280 18-12)
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N90-24316# National Aerospace Lab., Amsterdam (Netherlands).
EQUIVALENT FLEXIBILITY MODELING: A NOVEL APPROACH TOWARDS RECURSIVE SIMULATION OF FLEXIBLE SPACECRAFT MANIPULATOR DYNAMICS
P. Th. L. M. vanWoerkom *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 289-295 (For primary document see N90-24280 18-12)
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N90-24317# Technische Hochschule, Darmstadt (Germany, F.R.). Control Systems Theory and Robotics Section.
SIMULATION AND GROUND-BASED TESTING OF ORU-HANDLING WITH A BI-ARM ROBOT
H. Bruhm *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 299-308 (For primary document see N90-24280 18-12)
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N90-24318# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
ROSED: ROBOTIC SERVICING DEMONSTRATOR
M. VanWinnendael, P. Gallet, and P. FelixDelCueto (Construcciones Aeronauticas S.A., Madrid, Spain) *In its* Second European In-Orbit Operations Technology Symposium Dec. 1989 p 309-314 (For primary document see N90-24280 18-12)
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N90-24319# National Aerospace Lab., Emmeloord (Netherlands).
THE REAL-TIME HERMES ROBOT ARM SIMULATOR: HSF-P

J. J. M. Prins, P. Dielman, and H. deJong *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 315-321 Sponsored by Netherlands Agency for Aerospace Programs (For primary document see N90-24280 18-12)
(Contract ESA-7222/87/NL)
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N90-24323# G and H Technology, Inc., Paris (France).
INTERCONNECTING DEVICES CONCEIVED FOR IN-ORBIT OPERATIONS
Pietro Sequi and Joe Laffin (G and H Technology, Inc., Santa Monica, CA.) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 341-350 (For primary document see N90-24280 18-12)
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N90-24325# National Inst. of Standards and Technology, Gaithersburg, MD. Intelligent Controls Group.
NASREM: A FUNCTIONAL ARCHITECTURE FOR CONTROL OF THE FLIGHT TELEROBOTIC SERVICER
Ronald Lumia *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 361-365 (For primary document see N90-24280 18-12)
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N90-24327# Fokker B.V., Amsterdam (Netherlands).
THE HERMES ROBOT ARM: SYSTEM DESCRIPTION
R. J. Hamann and R. H. Bentall (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 373-379 (For primary document see N90-24280 18-12)
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N90-24328*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
NASA/GSFC SPLIT-RAIL PARALLEL GRIPPER
John M. Vranish and Mohammed Sharifi *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 383-387 (For primary document see N90-24280 18-12)
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N90-24329# Technische Hochschule, Darmstadt (Germany, F.R.). Control Systems Theory and Robotics Section.
A THREE FINGERED MULTIJOINTED GRIPPER AS A WORKING TOOL FOR EXPERIMENTAL USE
W. Paetsch and M. Kaneko (Ministry of International Trade and Industry, Tsukuba, Japan) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 389-392 Sponsored by BMFT (For primary document see N90-24280 18-12)
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N90-24331# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes en Recherches Aerospatiales.
DYNAMIC MODELING AND CONTROL OF A FLEXIBLE ARM HOLDING A NON-RIGID PAYLOAD
P. Carton, J. P. Chretien, and M. Maurette (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 405-411 Sponsored by CNES (For primary document see N90-24280 18-12)
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N90-24463# Lockheed Aircraft Corp., Palo Alto, CA.
DESIGN CONSIDERATIONS FOR PRECISION AND RELIABILITY IN SPACE MECHANISMS
Kenneth R. Lorell *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 3-10 (For primary document see N90-24462 18-31)
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N90-24464# Sener S.A., Las Arenas (Spain).
CONCEPT DESIGN FOR HERMES DOCKING/BERTHING MECHANISM
J. J. GonzalezVallejo *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 13-18 (For primary document see N90-24462 18-31)
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N90-24465# Societe Anonyme Belge de Constructions Aeronautiques, Brussels.
FLUID CONNECTORS FOR OPERATION IN SPACE
G. Bekaert and Neil Cable (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 19-23 (For primary document see N90-24462 18-31)
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N90-24467# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
A COMPACT JOINT FOR THE ROTEX MANIPULATOR
K. Priesett and W. Beckert *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 33-38 (For primary document see N90-24462 18-31)
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N90-24469# Institut National des Sciences Appliquees, Lyon (France). Lab. de Mecanique des Contacts.
INTERFACE TRIBOLOGY AND SPACE CONDITIONS
Y. Berthier, L. Flamand, M. Godet, and L. Petitjean (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 47-51 Sponsored by CNES (For primary document see N90-24462 18-31)
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N90-24470# Centre Suisse de Documentation dans le Domaine de la Microtechnique, Neuchatel.
TRIBOLOGICAL PROPERTIES OF PVD-APPLIED MoS2 COATINGS USED ON SPACE MECHANISMS
M. Maillat, C. Menoud, H. E. Hintermann, and J. F. Patin (Aerospatiale, Cannes, France) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 53-57 (For primary document see N90-24462 18-31)
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N90-24473# British Aerospace Public Ltd. Co., Bristol (England).
MULTI-APPLICATION SCANNING MECHANISM
M. E. Humphries and M. P. Hyam *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 75-80 Sponsored by United Kingdom MET Office (For primary document see N90-24462 18-31)
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N90-24474# Marconi Space Systems Ltd., Portsmouth (England).
A COMMUNICATIONS ANTENNA POINTING SYSTEM (CAPS): A MODULAR APPROACH
P. J. Whiteman *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 81-85 (For primary document see N90-24462 18-31)
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N90-24475# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
PRECISION POINTING AND LOCKING CAPABILITIES COMBINED BY A LINEAR ACTUATOR
M. Schmid and M. Gohl *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 87-92 (For primary document see N90-24462 18-31)
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N90-24476# Aerospatiale, Cannes (France).
WEARING OF CRYOMECHANISMS AT 4 K
Gerard Luciano *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 95-99 (For primary document see N90-24462 18-31)
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N90-24477# Toshiba Corp., Kanagawa (Japan).
STUDY OF BALL BEARINGS FOR SPACE USE
T. Kawamura, T. Honda, N. Kawashima, M. Nishimura, and K. Seki (National Aerospace Lab., Tokyo, Japan) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 101-107 (For primary document see N90-24462 18-31)
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N90-24478# ETEL S.A., Motiers (Switzerland).
DESIGN AND USE OF HIGH SPEED SYNCHRONOUS MOTOR RUNNING IN AGGRESSIVE LIQUIDS
N. Wavre *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 109-115 (For primary document see N90-24462 18-31)
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N90-24479# Ecole Centrale de Lyon (France). Lab. de Technologie des Surfaces.
WEAR OF GOLD-PLATED CONTACTS: MICROSCOPIC ASPECTS, ROLE OF OXYGEN
M. Belin, T. LeMogne, and J. M. Martin *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 117-121 Sponsored in part by Centre National d'Etudes et Telecommunications (For primary document see N90-24462 18-31)
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N90-24480# Aerospatiale, Cannes (France).
MECHANISMS TO ASSEMBLE SPACE STRUCTURES IN EXTRAVEHICULAR ENVIRONMENT
Freddy Geyer *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 125-128 (For primary document see N90-24462 18-31)
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N90-24482# Tecnospazio S.p.A., Milan (Italy).
EVA POWER TOOL PROTOTYPE
Maurizio Artesani *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 135-140 (For primary document see N90-24462 18-31)
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N90-24483# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
MECHANISMS ADD FOLDABILITY TO ROSAT SOLAR PANELS
H. Heimerdinger and P. H. Pawlowski (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany, F.R.) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 143-148 (For primary document see N90-24462 18-31)
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N90-24484# Cambridge Univ. (England). Dept. of Engineering.
A CABLE-RIGIDIZED 3D PANTOGRAPH
A. S. K. Kwan and S. Pellegrino *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 149-154 Sponsored by Cambridge Commonwealth Trust, England (For primary document see N90-24462 18-31)
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N90-24485# Aerospatiale, Cannes (France).
ADELE: DEPLOYMENT HINGE USING WRAPAROUND STRIPS [ADELE: ARTICULATION DE DEPLOIEMENT A LAMES D'ENROULEMENT]
Eric Blanc *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 155-158 (For primary document see N90-24462 18-31)
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N90-24486# Aeritalia S.p.A., Turin (Italy). Space Systems Group.
SOME REMARKS ON A HINGE ACTUATOR FOR LARGE SPOT ANTENNA ARM DEPLOYERS
Edmondo Turci *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 159-166 (For primary document see N90-24462 18-31)
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N90-24487# Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (Germany, F.R.).
THE LARGE WHEEL ACTUATOR LDR 100-0: DEVELOPMENT STATUS AND TEST RESULTS
H. Heimel *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 169-174 (For primary document see N90-24462 18-31)
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N90-24488# Sener S.A., Las Arenas (Spain).
CLAMPING DEVICE FOR PRESSURIZED MODULE RADIATOR PANEL
J. J. GonzalezVallejo, J. Arino, and L. Gutierrez *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 175-180 (For primary document see N90-24462 18-31)
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N90-24489# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
ANALYSIS AND TEST INTERACTION IN THE DEVELOPMENT OF A HOLD DOWN AND RELEASE MECHANISM
H.-J. Luhmann and C.-Ch. Etzler *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 181-186 (For primary document see N90-24462 18-31)
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N90-24490# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Dept. of Mechanical Systems
THE TETRAHEDRAL WEDGE ATTACHMENT MECHANISM
Neil Cable *In its* Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 187-194 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

N90-24492# Mullard Space Science Lab., Dorking (England).
FURTHER DEVELOPMENT OF THE CRYOGENIC FABRY-PEROT INTERCHANGE MECHANISM FOR ISO LWS
T. J. Patrick, G. R. Davis, I. Furniss, W. A. Towlson, and R. C. Sidey (Custom Developments Ltd., Richmond, England) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 203-205 (For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

N90-24493# I.A.M. Rinaldo Piaggio, Finale Ligure (Italy).
A SPRING-ACTUATED SPIN AND EJECT DEVICE FOR INTERPLANETARY MISSIONS
V. Comparetto and P. A. Coste (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Fourth European Space

Mechanisms and Tribology Symposium Mar. 1990 p 207-214 (For primary document see N90-24462 18-31)
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N90-24497# Sener S.A., Las Arenas (Spain).
DETACHABLE INTERFACE MECHANISM
M. Sierra and C. Pascual *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 235-240 (For primary document see N90-24462 18-31)
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N90-24498# Sira Inst. Ltd., Chislehurst (England).
SHUTTER MECHANISM FOR CONTROLLING THE EXPOSURE OF SAMPLES TO SOLAR RADIATION
W. A. Henton-Jones *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 241-248 (For primary document see N90-24462 18-31)
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N90-24499# Sira Inst. Ltd., Chislehurst (England).
MECHANISM FOR DEPLOYMENT AND RETRACTION OF BIOLOGICAL SAMPLES
W. A. Henton-Jones *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 249-256 (For primary document see N90-24462 18-31)
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N90-24502# Marconi Space Systems Ltd., Portsmouth (England).
HEMISPHERICAL POINTING MECHANISM
Karl Gallagher *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 273-279 (For primary document see N90-24462 18-31)
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N90-24504# Sener S.A., Las Arenas (Spain).
A SEQUENTIALLY DEPLOYABLE STRUCTURE FOR SPACE APPLICATIONS. PART 2: ENGINEERING MODEL MANUFACTURING AND TESTING
J. Rivacoba, M. Sierra, J. Unda, and M. Eiden (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 289-294 (For primary document see N90-24462 18-31)
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N90-24505# Centre Suisse de Documentation dans le Domaine de la Microtechnique, Neuchatel.
TRIBOLOGY OF MoS2: EFFECT OF FILM THICKNESS
M. Maillat, L. Chollet, H. E. Hintermann, D. Costa, and F. Levy (Ecole Polytechnique Federale de Lausanne, Switzerland) *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 295-298 Sponsored by Fondation Suisse pour la Recherche en Microtechnique (For primary document see N90-24462 18-31)
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N90-24508# British Aerospace Public Ltd. Co., Stevenage (England).
INMARSAT OMNI-ANTENNA DEPLOYMENT MECHANISM
P. McMahon *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 311-315 (For primary document see N90-24462 18-31)
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38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N90-24974*# Houston Univ., TX. Dept. of Applied Mathematical Sciences.
A BAYESIAN APPROACH TO RELIABILITY AND CONFIDENCE Final Report
Ron Barnes *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 11 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 14D

N90-24992*# Virginia Commonwealth Univ., Richmond. Dept. of Mathematical Sciences.
EVALUATING STATISTICAL PROCESS CONTROL (SPC) TECHNIQUES AND COMPUTING THE UNCERTAINTY OF FORCE CALIBRATIONS Final Report
Sharon E. Navard *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 15 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 14D

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N90-24636*# Polytechnic Univ., Farmingdale, NY. Research Inst.
REVIEW OF PROBABILISTIC ANALYSIS OF DYNAMIC RESPONSE OF SYSTEMS WITH RANDOM PARAMETERS Final Report
F. Kozin and J. M. Klosner Dec. 1989 38 p
(Grant NAG1-986)
(NASA-CR-186171; NAS 1.26:186171; POLY-WRI-1569-89)
Avail: NTIS HC A03/MF A01 CSCL 20K

The various methods that have been studied in the past to allow probabilistic analysis of dynamic response for systems with random parameters are reviewed. Dynamic response may have been obtained deterministically if the variations about the nominal values were small; however, for space structures which require precise pointing, the variations about the nominal values of the structural details and of the environmental conditions are too large to be considered as negligible. These uncertainties are accounted for in terms of probability distributions about their nominal values. The quantities of concern for describing the response of the structure includes displacements, velocities, and the distributions of natural frequencies. The exact statistical characterization of the response would yield joint probability distributions for the response variables. Since the random quantities will appear as coefficients, determining the exact distributions will be difficult at best. Thus, certain approximations will have to be made. A number of techniques that are available are discussed, even in the nonlinear case. The methods that are described were: (1) Liouville's equation; (2) perturbation methods; (3) mean square approximate systems; and (4) nonlinear systems with approximation by linear systems.
M.G.

N90-24637*# Computer Software Management and Information Center, Athens, GA.
EIGHTEENTH NASTRAN (R) USERS' COLLOQUIUM
Washington NASA Apr. 1990 176 p Colloquium held in Portland, OR, 23-27 Apr. 1990 Sponsored by NASA, Washington
(NASA-CP-3069; NAS 1.55:3069) Avail: NTIS HC A09/MF

A01; also available from COSMIC, Athens, GA 30602 CSCL 20K

This publication is the proceedings of the Eighteenth NASTRAN Users' Colloquium held in Portland, Oregon, April 23-27, 1990. It provides some comprehensive general papers on the application of finite elements in engineering, comparisons with other approaches, unique applications, pre- and post-processing or auxiliary programs, and new methods of analysis with NASTRAN. For individual titles, see N90-24638 through N90-24650.

N90-24638*# Rockwell International Corp., Downey, CA.
A NASTRAN TRAINER FOR DYNAMICS
H. R. Grooms, P. J. Hinz, and G. L. Commerford *In* COSMIC, 18th NASTRAN (R) Users' Colloquium Apr. 1990 p 1-13 (For primary document see N90-24637 18-39)
Avail: NTIS HC A09/MF A01; also available from COSMIC, Athens, GA 30602 CSCL 20K

Presented here is an automated training tool that engineers can use to master the application of NASTRAN to dynamic problems. Example problems were selected to make classical solutions available for comparison. These comparisons can be used to evaluate the solution. Author

N90-24639*# Chrysler Technologies Airborne Systems, Inc., Waco, TX.
PCI: A PATRAN-NASTRAN MODEL TRANSLATOR
T. J. Sheerer *In* COSMIC, 18th NASTRAN (R) Users' Colloquium Apr. 1990 p 14-19 (For primary document see N90-24637 18-39)
Avail: NTIS HC A09/MF A01; also available from COSMIC, Athens, GA 30602 CSCL 20K

The amount of programming required to develop a PATRAN-NASTRAN translator was surprisingly small. The approach taken produced a highly flexible translator comparable with the PATNAS translator and superior to the PATCOS translator. The coding required varied from around ten lines for a shell element to around thirty for a bar element, and the time required to add a feature to the program is typically less than an hour. The use of a lookup table for element names makes the translator also applicable to other versions of NASTRAN. The saving in time as a result of using PDA's Gateway utilities was considerable. During the writing of the program it became apparent that, with a somewhat more complex structure, it would be possible to extend the element data file to contain all data required to define the translation from PATRAN to NASTRAN by mapping of data between formats. Similar data files on property, material and grid formats would produce a completely universal translator from PATRAN to any FEA program, or indeed any CAE system. Author

N90-24640*# Texas A&M Univ., College Station.
A GENERIC INTERFACE BETWEEN COSMIC/NASTRAN AND PATRAN (R)
Paul N. Roschke, Prakit Premthamkorn, and James C. Maxwell *In* COSMIC, 18th NASTRAN (R) User's Colloquium Apr. 1990 p 20-29 (For primary document see N90-24637 18-39)
Avail: NTIS HC A09/MF A01; also available from COSMIC, Athens, GA 30602 CSCL 20K

Despite its powerful analytical capabilities, COSMIC/NASTRAN lacks adequate post-processing adroitness. PATRAN, on the other hand is widely accepted for its graphical capabilities. A nonproprietary, public domain code mnemonically titled CPI (for COSMIC/NASTRAN-PATRAN Interface) is designed to manipulate a large number of files rapidly and efficiently between the two parent codes. In addition to PATRAN's results file preparation, CPI also prepares PATRAN's P/PLOT data files for xy plotting. The user is prompted for necessary information during an interactive session. Current implementation supports NASTRAN's displacement approach including the following rigid formats: (1) static analysis, (2) normal modal analysis, (3) direct transient response, and (4) modal transient response. A wide variety of data blocks are also supported. Error trapping is given special consideration. A sample session with CPI illustrates its simplicity and ease of use. Author

N90-24641*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ACCURACY OF THE QUAD4 THICK SHELL ELEMENT
William R. Case, Tiffany D. Bowles, Alicia K. Croft, and Mark A. McGinnis *In* COSMIC, 18th NASTRAN (R) Users' Colloquium Apr. 1990 p 30-60 (For primary document see N90-24637 18-39)
Avail: NTIS HC A09/MF A01; also available from COSMIC, Athens, GA 30602 CSCL 20K

The accuracy of the relatively new QUAD4 thick shell element is assessed via comparison with a theoretical solution for thick homogeneous and honeycomb flat simply supported plates under the action of a uniform pressure load. The theoretical thick plate solution is based on the theory developed by Reissner and includes the effects of transverse shear flexibility which are not included in the thin plate solutions based on Kirchoff plate theory. In addition, the QUAD4 is assessed using a set of finite element test problems developed by the MacNeal-Schwendler Corp. (MSC). Comparison of the COSMIC QUAD4 element as well as those from MSC and Universal Analytics, Inc. (UAI) for these test problems is presented. The current COSMIC QUAD4 element is shown to have excellent comparison with both the theoretical solutions and also those from the two commercial versions of NASTRAN that it was compared to. Author

N90-24642*# Los Alamos National Lab., NM.
EIGENVALUE COMPUTATIONS WITH THE QUAD4 CONSISTENT-MASS MATRIX
Thomas A. Butler *In* COSMIC, 18th NASTRAN (R) User's Colloquium Apr. 1990 p 61-72 (For primary document see N90-24637 18-39)
Avail: NTIS HC A09/MF A01; also available from COSMIC, Athens, GA 30602 CSCL 20K

The NASTRAN user has the option of using either a lumped-mass matrix or a consistent- (coupled-) mass matrix with the QUAD4 shell finite element. At the Sixteenth NASTRAN Users' Colloquium (1988), Melvyn Marcus and associates of the David Taylor Research Center summarized a study comparing the results of the QUAD4 element with results of other NASTRAN shell elements for a cylindrical-shell modal analysis. Results of this study, in which both the lumped-and consistent-mass matrix formulations were used, implied that the consistent-mass matrix yielded poor results. In an effort to further evaluate the consistent-mass matrix, a study was performed using both a cylindrical-shell geometry and a flat-plate geometry. Modal parameters were extracted for several modes for both geometries leading to some significant conclusions. First, there do not appear to be any fundamental errors associated with the consistent-mass matrix. However, its accuracy is quite different for the two different geometries studied. The consistent-mass matrix yields better results for the flat-plate geometry and the lumped-mass matrix seems to be the better choice for cylindrical-shell geometries. Author

N90-24643*# Unisys Corp., Huntsville, AL.
NASTRAN MIGRATION TO UNIX
Gordon C. Chan and Horace Q. Turner *In* COSMIC, 18th NASTRAN (R) User's Colloquium Apr. 1990 p 73-76 (For primary document see N90-24637 18-39)
Avail: NTIS HC A09/MF A01; also available from COSMIC, Athens, GA 30602 CSCL 20K

COSMIC/NASTRAN, as it is supported and maintained by COSMIC, runs on four main-frame computers - CDC, VAX, IBM and UNIVAC. COSMIC/NASTRAN on other computers, such as CRAY, AMDAHL, PRIME, CONVEX, etc., is available commercially from a number of third party organizations. All these computers, with their own one-of-a-kind operating systems, make NASTRAN machine dependent. The job control language (JCL), the file management, and the program execution procedure of these computers are vastly different, although 95 percent of NASTRAN source code was written in standard ANSI FORTRAN 77. The advantage of the UNIX operating system is that it has no machine boundary. UNIX is becoming widely used in many workstations, mini's, super-PC's, and even some main-frame computers.

NASTRAN for the UNIX operating system is definitely the way to go in the future, and makes NASTRAN available to a host of computers, big and small. Since 1985, many NASTRAN improvements and enhancements were made to conform to the ANSI FORTRAN 77 standards. A major UNIX migration effort was incorporated into COSMIC NASTRAN 1990 release. As a pioneer work for the UNIX environment, a version of COSMIC 89 NASTRAN was officially released in October 1989 for DEC ULTRIX VAXstation 3100 (with VMS extensions). A COSMIC 90 NASTRAN version for DEC ULTRIX DECstation 3100 (with RISC) is planned for April 1990 release. Both workstations are UNIX based computers. The COSMIC 90 NASTRAN will be made available on a TK50 tape for the DEC ULTRIX workstations. Previously in 1988, an 88 NASTRAN version was tested successfully on a SiliconGraphics workstation. Author

N90-24644*# RPK Corp., Columbia, MD.
OBTAINING EIGENSOLUTIONS FOR MULTIPLE FREQUENCY RANGES IN A SINGLE NASTRAN EXECUTION
P. R. Pamidi and W. K. Brown (RPK Corp., Hayes, VA.) *In* COSMIC, 18th NASTRAN (R) Users' Colloquium Apr. 1990 p 77-89 (For primary document see N90-24637 18-39)
Avail: NTIS HC A09/MF A01; also available from COSMIC, Athens, GA 30602 CSCL 20K

A novel and general procedure for obtaining eigenvalues and eigenvectors for multiple frequency ranges in a single NASTRAN execution is presented. The scheme is applicable to normal modes analyzes employing the FEER and Inverse Power methods of eigenvalue extraction. The procedure is illustrated by examples. Author

N90-24645*# General Electric Co., Houston, TX. Government Services.
RANDOM VIBRATION ANALYSIS OF SPACE FLIGHT HARDWARE USING NASTRAN
S. K. Thampi and S. N. Vidyasagar *In* COSMIC, 18th NASTRAN (R) Users' Colloquium Apr. 1990 p 90-106 (For primary document see N90-24637 18-39)
Avail: NTIS HC A09/MF A01; also available from COSMIC, Athens, GA 30602 CSCL 20K

During liftoff and ascent flight phases, the Space Transportation System (STS) and payloads are exposed to the random acoustic environment produced by engine exhaust plumes and aerodynamic disturbances. The analysis of payloads for randomly fluctuating loads is usually carried out using the Miles' relationship. This approximation technique computes an equivalent load factor as a function of the natural frequency of the structure, the power spectral density of the excitation, and the magnification factor at resonance. Due to the assumptions inherent in Miles' equation, random load factors are often over-estimated by this approach. In such cases, the estimates can be refined using alternate techniques such as time domain simulations or frequency domain spectral analysis. Described here is the use of NASTRAN to compute more realistic random load factors through spectral analysis. The procedure is illustrated using Spacelab Life Sciences (SLS-1) payloads and certain unique features of this problem are described. The solutions are compared with Miles' results in order to establish trends at over or under prediction. Author

N90-24646*# Butler Analyses, Towson, MD.
OBTAINING AN EQUIVALENT BEAM
Thomas G. Butler *In* COSMIC, 18th NASTRAN (R) Users' Colloquium Apr. 1990 p 107-114 (For primary document see N90-24637 18-39)
Avail: NTIS HC A09/MF A01; also available from COSMIC, Athens, GA 30602 CSCL 20K

In modeling a complex structure the researcher was faced with a component that would have logical appeal if it were modeled as a beam. The structure was a mast of a robot controlled gantry crane. The structure up to this point already had a large number of degrees of freedom, so the idea of conserving grid points by modeling the mast as a beam was attractive. The researcher decided to make a separate problem of of the mast and model it in three dimensions with plates, then extract the equivalent beam properties by setting up the loading to simulate beam-like deformation and constraints. The results could then be used to represent the mast as a beam in the full model. A comparison was made of properties derived from models of different constraints versus manual calculations. The researcher shows that the three-dimensional model is ineffective in trying to conform to the requirements of an equivalent beam representation. If a full 3-D plate model were used in the complete representation of the crane structure, good results would be obtained. Since the attempt is to economize on the size of the model, a better way to achieve the same results is to use substructuring and condense the mast to equivalent end boundary and intermediate mass points. Author

N90-24647*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
LOW VELOCITY IMPACT ANALYSIS WITH NASTRAN
Daniel A. Trowbridge (Analex Corp., Fairview Park, OH.), Joseph E. Grady, and Robert A. Aiello *In* COSMIC, 18th NASTRAN (R) Users' Colloquium Apr. 1990 p 115-134 Sponsored in part by Naval Weapons Center, China Lake, CA (For primary document see N90-24637 18-39)
Avail: NTIS HC A09/MF A01; also available from COSMIC, Athens, GA 30602 CSCL 20K

A nonlinear elastic force-displacement relationship is used to calculate the transient impact force and local deformation at the point of contact between impactor and target. The nonlinear analysis and transfer function capabilities of NASTRAN are used to define a finite element model that behaves globally linearly elastic, and locally nonlinear elastic to model the local contact behavior. Results are presented for two different structures: a uniform cylindrical rod impacted longitudinally; and an orthotropic plate impacted transversely. Calculated impact force and transient structural response of the targets are shown to compare well with results measured in experimental tests. Author

N90-24648*# Naval Ship Research and Development Center, Bethesda, MD. Applied Mathematics Div.
TRANSITIONING OF POWER FLOW IN BEAM MODELS WITH BENDS
Stephen A. Hambric *In* COSMIC, 18th NASTRAN (R) Users' Colloquium Apr. 1990 p 135-149 (For primary document see N90-24637 18-39)
Avail: NTIS HC A09/MF A01; also available from COSMIC, Athens, GA 30602 CSCL 20K

The propagation of power flow through a dynamically loaded beam model with 90 degree bends is investigated using NASTRAN and McPOW. The transitioning of power flow types (axial, torsional, and flexural) is observed throughout the structure. To get accurate calculations of the torsional response of beams using NASTRAN, torsional inertia effects had to be added to the mass matrix calculation section of the program. Also, mass effects were included in the calculation of BAR forces to improve the continuity of power flow between elements. The importance of including all types of power flow in an analysis, rather than only flexural power, is indicated by the example. Trying to interpret power flow results that only consider flexural components in even a moderately complex problem will result in incorrect conclusions concerning the total power flow field. Author

N90-24649*# Naval Ship Research and Development Center, Bethesda, MD. Applied Mathematics Div.
COUPLED BE/FE/BE APPROACH FOR SCATTERING FROM FLUID-FILLED STRUCTURES
Gordon C. Everstine and Raymond S. Cheng *In* COSMIC, 18th NASTRAN (R) Users' Colloquium Apr. 1990 p 150-164 (For primary document see N90-24637 18-39)
Avail: NTIS HC A09/MF A01; also available from COSMIC, Athens, GA 30602 CSCL 20K

NASHUA is a coupled finite element/boundary element capability built around NASTRAN for calculating the low frequency far-field acoustic pressure field radiated or scattered by an arbitrary, submerged, three-dimensional, elastic structure subjected to either

internal time-harmonic mechanical loads or external time-harmonic incident loadings. Described here are the formulation and use of NASHUA for solving such structural acoustics problems when the structure is fluid-filled. NASTRAN is used to generate the structural finite element model and to perform most of the required matrix operations. Both fluid domains are modeled using the boundary element capability in NASHUA, whose matrix formulation (and the associated NASTRAN DMAP) for evacuated structures can be used with suitable interpretation of the matrix definitions. After computing surface pressures and normal velocities, far-field pressures are evaluated using an asymptotic form of the Helmholtz exterior integral equation. The proposed numerical approach is validated by comparing the acoustic field scattered from a submerged fluid-filled spherical thin shell to that obtained with a series solution, which is also derived here. Author

N90-24650*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MONITORING OF RITZ MODAL GENERATION
Mladen Chargin and Thomas G. Butler (Butler Analyses, Towson, MD.) *In* COSMIC, 18th NASTRAN (R) Users' Colloquium Apr. 1990 p 165-170 (For primary document see N90-24637 18-39)
Avail: NTIS HC A09/MF A01; also available from COSMIC, Athens, GA 30602 CSCL 20K

A scheme is proposed to monitor the adequacy of a set of Ritz modes to represent a solution by comparing the quantity generated with certain properties involving the forcing function. In so doing an attempt was made to keep this algorithm lean and efficient, so that it will be economical to apply. Using this monitoring scheme during Ritz Mode generation will automatically ensure that the k Ritz modes theta k that are generated are adequate to represent both the spatial and temporal behavior of the structure when forced under the given transient condition defined by F(s,t). Author

N90-24651 Council for National Academic Awards (England).
ACCURACY IMPROVEMENTS IN FINITE ELEMENT STRESS ANALYSIS Ph.D. Thesis
Michael John Daniels 1989 306 p
Avail: Univ. Microfilms Order No. BRDX87711

A surface stress enhancement procedure for use in elastic-static finite element stress analysis was developed and implemented. Using the displacement-based formulation of the finite element method, solutions, though generally of acceptable accuracy, may lack the required precision at critical points, this being especially the case for regions of locally high stress. While, given an adequate finite element model, displacements can be obtained with good accuracy, the strains and hence stresses, obtained from differentiating the approximating element-displacement functions, will be inferior. The stress enhancement procedure provides a means of improving the quality of surface stress predictions more economically than by the use of model enrichment employing conventional procedures. The essence of the refinement process is the utilization of conventionally-obtained nodal displacements in a least-squares minimization of the deviation of these quantities from displacements based on extended polynomials, subject to constraints of satisfying boundary traction equilibrium. The process is applied to cases of plane stress/strain, axisymmetric solids, and non-axisymmetric loading of axisymmetric solids, and the preparatory work for fully three-dimensional applications is completed. Elements belonging to the isoparametric family with an assumed quadratic displacement pattern were chosen, and the necessary routines were designed to interface with an existing finite element suite. Application to a range of examples reveals consistently smooth distributions in which inter-element stress discontinuities and intra-element parabolic looping, often exhibited by conventional solutions, are generally absent. Comparison of the enhanced stresses with results of recognized accuracy is favorable and demonstrates significant improvements in the quality of predictions over those obtained conventionally. The refinement represents only a modest 5 to 10 percent increase in computational cost beyond that for a conventional solution. Dissert. Abstr.

N90-24652# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
COMPUTATIONAL METHODS AND PLASTICITY
Z. Waszczyszyn Feb. 1989 220 p
(PB90-167917; LR-583) Avail: NTIS HC A10/MF A02 CSCL 20K

There is an extended literature on the computation methods for the analysis of elastic-plastic problems. The report reflects a certain selection made according to the following suppositions: Only main assumptions, relations and theorems of the theory of deformable bodies-especially with the theory of elasticity and plasticity, with structural mechanics and the finite element method, as well as with tensorial and matrix calculus, are presented without any derivation or proof. The critical point of consideration refers to selection of material models suitable for the computational analysis. In the course the attention will be focused on metals and their alloys. Hence models with symmetric properties with respect to tension and compression, homogeneous and initially isotropic will be preferred. There will be presented computational methods developed for the elastoplastic analysis of the full deformation process. Geometrical and material nonlinear problems will be considered from the viewpoint of the displacement formulation of the finite element method. Large strains, temperature dependence of material properties, cyclic loading, and rate dependence will be shortly discussed as examples of an extension of the classical concepts of plasticity. Specific problems of the elastic-plastic buckling analysis of structures will be pointed out. DOE

N90-24653*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
ANALYSIS OF SHELL-TYPE STRUCTURES SUBJECTED TO TIME-DEPENDENT MECHANICAL AND THERMAL LOADING Final Technical Report, 15 Apr. 1984 - 10 Mar. 1990
George J. Simitses Mar. 1990 91 p
(Grant NAG3-534)
(NASA-CR-185077; NAS 1.26:185077) Avail: NTIS HC A05/MF A01 CSCL 20K

The development of a general mathematical model and solution methodologies for analyzing structural response of thin, metallic shell-like structures under dynamic and/or static thermomechanical loads is examined. In the mathematical model, geometric as well as material-type of nonlinearities are considered. Traditional as well as novel approaches are reported and detailed applications are presented in the appendices. The emphasis for the mathematical model, the related solution schemes, and the applications, is on thermal viscoelastic and viscoplastic phenomena, which can predict creep and ratchetting. Author

N90-24654# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A NUMERICAL STUDY OF PLASTICITY INDUCED CLOSURE IN SHORT CRACKS BY THE FINITE ELEMENT METHOD Ph.D. Thesis
Eugene J. Bednarz Jan. 1990 186 p
(AD-A220471; AFIT/DS/ENY/90-1) Avail: NTIS HC A09/MF A01 CSCL 11/6

Plasticity induced closure and its effect on the fatigue growth of short cracks were investigated analytically in a high strength titanium alloy at room temperature as well as in a nickel base alloy at elevated temperature. The analysis consisted of subjecting a single-edge cracked specimen with an initial crack length of .001 inch to cyclic loading and allowing the crack to propagate. This was accomplished using a two-dimensional finite element code and a theoretical finite element model of a typical test geometry. Visco 2, the two-dimensional plane stress/plane strain finite element code, uses constant strain triangular elements and incorporates the Bodner-Partom Viscoplastic Flow Law to handle non-linear material behavior. The numerical simulations involved subjecting specimens of TI-6246 at room temperature

(time-independent behavior) to cyclic loads with maximum nominal stress values of approximately 60 and 90 percent of the material yield strength and load ratios of -1.0 and 0.1 with a frequency of 1.0 Hz. The numerical simulations of specimens consisting of Inconel 718 at 1200 F (time-dependent behavior) consisted of cyclic loads where the maximum nominal stress was .90 yield strength, the applied load ratio was 0.1, and the cyclic frequencies were .01 and 1.0 Hz. The formation of a plastic wake and the affects of plasticity induced closure were observed in these specimens. GRA

N90-24655# Sandia National Labs., Albuquerque, NM. Applied Mechanics Div.

A VECTROIZED ELASTIC/PLASTIC POWER LAW HARDENING MATERIAL MODEL INCLUDING LUEDERS STRAIN

Charles M. Stone, Gerald W. Wellman, and Raymond D. Krieg (Tennessee Univ., Knoxville.) Mar. 1990 22 p
(Contract DE-AC04-76DP-00789)
(DE90-010172; SAND-90-0153) Avail: NTIS HC A03/MF A01

An elastic/plastic material model has been developed for use with the suite of Sandia Engineering Analysis Department finite element codes. This model describes post-yield strain hardening by a power law equation involving the equivalent plastic strain and includes a yield plateau or Lueders strain region. This combination of power law hardening and Lueders strain accurately represents the mechanical behavior of a large number of commonly used engineering materials. The material model is vectorized to take advantage of current super-computer architecture. The model shows only a modest increase in CPU time over the linear hardening material model currently in the codes. Several example problems are presented to show the accuracy and flexibility of the elastic/plastic power law hardening model. DOE

N90-24656# Oak Ridge National Lab., TN.

IRRADIATION ASSISTED STRESS CORROSION CRACKING

Graham E. C. Bell 30 Apr. 1990 9 p
(Contract DE-AC05-84OR-21400)
(DE90-010629; ORNL/FTR-3601) Avail: NTIS HC A02/MF A01

The traveler attended the ICG-IASCC and presented recent results from electrochemical experiments on prime candidate alloy (PCA) irradiated in FFTF/MOTA. The traveler's results, as well as those of others, illustrated the importance of irradiation-produced microstructures, aqueous radiation chemistry, and mechanical loading conditions in understanding irradiation assisted stress corrosion cracking (IASCC). The traveler also visited facilities at JAERI and discussed areas for future collaboration on fusion reactor materials. Plans for a three-month assignment of the traveler to JAERI in Tokai-mura were discussed. DOE

N90-24657# Oak Ridge National Lab., TN. Metals and Ceramics Div.

INDENTATION FRACTURE OF BRITTLE MATERIALS

Barry N. Lucas, W. C. Oliver, and J. J. Wert (Vanderbilt Univ., Nashville, TN.) 1990 7 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract DE-AC05-84OR-21400)
(DE90-010709; CONF-900466-28) Avail: NTIS HC A02/MF A01

The response of four transparent materials, soda-lime glass, fused silica, single crystal (0001) Al2 O3 and Y2 O3-ZrO2 to contact by a sharp indenter has been studied. In-situ observation and continuous monitoring of the load and displacement throughout the test allowed the indentation fracture sequence of the transparent materials to be characterized and also permitted the effects of these fracture events on the corresponding load displacement curves to be noted. It was found that if the cracks produced during indentation grew discontinuously, they manifested themselves in discontinuities in displacement on the corresponding load-displacement curve. DOE

N90-24658# Technische Univ., Delft (Netherlands).

ASYMPTOTIC ANALYSIS OF WIND-INDUCED VIBRATIONS Ph.D. Thesis

Clemens Georges Andr vanderBeek 1989 192 p Sponsored by Netherlands Foundation for Mathematics and Netherlands Organization for Scientific Research
(ETN-90-96903) Avail: NTIS HC A09/MF A01

Two types of differential equations occurring frequently in wind-induced vibrations are studied. Several models, describing the wind-induced vibrations of an oscillator with one, two and three degrees of freedom are discussed. An algorithm for the calculation of the normalized differential equations, which are used to obtain existence, uniqueness and stability of periodic solutions, is presented. An algorithm to calculate the normal form for a class of weakly nonlinear perturbed wave equations is presented, and using the Galerkin method a relation is found between this normal form and the previous one. As an application and illustration of the theory an initial boundary problem for the Rayleigh wave equation is discussed. ESA

N90-24659# Technische Univ., Eindhoven (Netherlands).

ADVANCED BUCKLING ANALYSES OF BEAMS WITH ARBITRARY CROSS SECTIONS Ph.D. Thesis

Geradus Maria vanErp 1989 131 p Sponsored by Netherlands Technology Foundation
(ISBN-90-9002808-0; ETN-90-96897) Avail: NTIS HC A07/MF A01

A computer program was developed to study distorsion of the cross section during buckling and the interaction between buckling modes, based on the combination of the spline finite strip method and Koiter's general theory of stability. A theory was developed to derive the energy functional which governs the flexural-torsional buckling behavior of mono and doubly symmetric beams which exhibit large prebuckling displacements. General equations were solved using finite element formulation with Hermite cubic interpolation functions for each element. Saint Venant's warping formulation and an alternative one where the amplitude of the warping distribution depends on an unknown function were used. The differences found were negligible. A computer program to determine geometric properties of beams with arbitrary cross sections was developed. ESA

N90-24660*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

UNIQUE FAILURE BEHAVIOR OF METAL/COMPOSITE AIRCRAFT STRUCTURAL COMPONENTS UNDER CRASH TYPE LOADS

Huey D. Carden May 1990 32 p
(NASA-TM-102679; NAS 1.15:102679) Avail: NTIS HC A03/MF A01 CSCL 20K

Failure behavior results are presented on some of the crash dynamics research conducted with concepts of aircraft elements and substructure which have not necessarily been designed or optimized for energy absorption or crash loading considerations. To achieve desired new designs which incorporate improved energy absorption capabilities often requires an understanding of how more conventional designs behave under crash type loadings. Experimental and analytical data are presented which indicate some general trends in the failure behavior of a class of composite structures which include individual fuselage frames, skeleton subfloors with stringers and floor beams but without skin covering, and subfloors with skin added to the frame-stringer arrangement. Although the behavior is complex, a strong similarity in the static/dynamic failure behavior among these structures is illustrated through photographs of the experimental results and through analytical data of generic composite structural models. It is believed that the thread of similarity in behavior is telling the designer and dynamists a great deal about what to expect in the crash behavior of these structures and can guide designs for improving the energy absorption and crash behavior of such structures. Author

N90-24661# Societe Bertin et Cie, Plaisir (France).
NON DESTRUCTIVE TESTING OF COMPOSITE STRUCTURES USING EMBEDDED OPTICAL FIBERS: A MECHANICAL INTERACTION MODEL
D. Engrand, F. Lecuyer, and P. Sansonetti Feb. 1990 14 p (ETN-90-97016) Avail: NTIS HC A03/MF A01

Due to their sensitivity to strain, optical fibers may be used as permanent sensors when embedded in composite structures. However, interpretation of measurements through optical parameter variation is possible only if the state of strain in the sensor itself can be related to the state of strain in the composite. A mechanical model which is able to relate in as one-to-one relation the average strain in the sensor to the composite strain is presented. This model is based on micromechanical analysis together with closed form exact elasticity solutions. By use of such a model, it is also possible to evaluate all the perturbations occurring in the composite due to the presence of the sensor (extent of perturbed area, stiffness modification, strength reduction). In addition, the effect of the sensor's coating can be investigated and optimized. ESA

N90-24358*# East Carolina Univ., Greenville, NC. Dept. of Construction Management.
EXPERIMENTAL DETERMINATION OF MATERIAL DAMPING USING VIBRATION ANALYZER
Mostafiz R. Chowdhury and Farida Chowdhury *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials and Science Technology May 1990 p 53-63 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 20K

N90-25039*# Jackson State Univ., MS. Dept. of Technology.
STRUT-NODE JOINT CONJUGATES FOR THE ASSEMBLY OF SEMI-PERMANENT OR REUSABLE TRUSS STRUCTURES
W. V. Brewer *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 50-55 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20K

N90-25042*# New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
STRUCTURAL ZOOMING RESEARCH AND DEVELOPMENT OF AN INTERACTIVE COMPUTER GRAPHICAL INTERFACE FOR STRESS ANALYSIS OF CRACKS
Walter Gerstle *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 67-68 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20K

N90-25048*# Oregon State Univ., Corvallis. Dept. of Civil Engineering.
DYNAMIC ANALYSIS OF FLEXIBLE MULTIBODY STRUCTURES Abstract Only
Alan G. Hernried *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 79-80 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20K

N90-25052*# South Carolina State Coll., Orangeburg. Dept. of Civil and Mechanical Engienering.
FATIGUE ANALYSIS OF MINI-MAST SPACE TRUSS Abstract Only
Shoi Y. Hwang *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 89-90 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20K

N90-25055*# College of William and Mary, Williamsburg, VA. Dept. of Mathematics.
MINIMIZING DISTORTION AND INTERNAL FORCES IN TRUSS STRUCTURES BY SIMULATED ANNEALING
Rex K. Kincaid *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 95-102 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20K

N90-25060*# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.
MODELING GROWTH OF FATIGUE CRACKS WHICH ORIGINATE AT RIVET HOLES Abstract Only
Mark E. Mear *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 125-126 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20K

N90-25062*# Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
FLEXURAL FATIGUE LIFE PREDICTION OF CLOSED HAT-SECTION USING MATERIALLY NONLINEAR AXIAL FATIGUE CHARACTERISTICS Abstract Only
Zia Razzaq *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 131-132 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20E

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N90-24662 California Univ., Santa Barbara.
DEVELOPMENT OF REMOTE SENSING TECHNIQUES FOR THE INVESTIGATION OF NEOTECTONIC ACTIVITY, EASTERN TRANSVERSE RANGES AND VICINITY, SOUTHERN CALIFORNIA Ph.D. Thesis
Robert Edward Crippen 1989 324 p
Avail: Univ. Microfilms Order No. DA9009533

The fundamental goal in processing remote sensing imagery for geologic interpretation is to clearly present a maximal amount of pertinent information. Achieving this goal requires optimal selection, refinement, and depiction of spectral data sets. Correlation among bands or band ratios is inversely related to the prominence of the spectral contrasts that they depict. Correlation analysis is therefore appropriate for guiding band and band-ratio selection. Analyses of imagery and laboratory spectra indicate that for LANDSAT TM reflectance data, bands 1,4,7 (general lithology) or 1,5,7 (hydroxyl-rich lithology) and ratios 3/1,5/4,5/7 are preferable for lithologic discrimination. Band ratios are related to overall bispectral reflectance and the slopes of spectral curves in relation to each other. Mixed pixels can be difficult to interpret in ratio images because ratios of averaged radiances are not functionally related to averages of ratioed radiances. The linearity of relationships between surface variables and some band ratio

transforms is strongly affected by sensor gains but can also be affected beneficially by user applied multiplicative constants. Ratios of recorded radiance are approximately functionally related to ratios of surface reflectance only if the additive terms of recorded radiance are removed. In well-exposed, rugged terrain these terms can be estimated directly from image data, even if pixels of zero ground radiance are not present. Four components of spectral data can be displayed and interpreted in a color composite image. One achromatic component is merged with each of three chromatic components by multiplication. The distinctiveness of spatial properties in the achromatic component prevents most perceptual confusion. Consequently, this compaction of data into three-dimensional color space is highly useful. Dissert. Abstr.

N90-24663# Colorado Univ., Boulder. Dept. of Physics.
GEOPHYSICAL STUDIES RELATED TO GEODETIC REFERENCE FRAMES Final Report, 2 Apr. 1986 - 30 Apr. 1989
John Wahr 9 Feb. 1990 87 p
(Contract F19628-86-K-0011)
(AD-A220249; GL-TR-89-0308) Avail: NTIS HC A05/MF A01 CSCL 08/5

Areas of study were: (1) The development of models to estimate the effects of atmospheric pressure loading on surface displacements and surface gravity; (2) The effects were investigated of aspherical core structure on the forced nutations; (3) The possibility was studied of aspherical structure inside the core, and its possible implications for geodetic and seismic constraints on the core-mantle boundary topography; (4) A study was begun of the ocean's response to pressure, and its implications for certain geodetic observations. So far, it has concentrated on trying to assess the accuracy of pressure data sets over the ocean; and (5) Monthly, global tide gauge data to were used investigate certain long periodoceanic disturbances which have implications for the interpretation of geodetic (e.g., rotation, earth tide, crustal dynamics) data. GRA

N90-24664*# Purdue Univ., West Lafayette, IN. School of Electrical Engineering.
SPECTRAL FEATURE DESIGN IN HIGH DIMENSIONAL MULTISPECTRAL DATA
Chih-Chien Thomas Chen and David A. Landgrebe Aug. 1988 149 p
(Grant NAGw-925)
(NASA-CR-186647; NAS 1.26:186647; TR-EE-88-35) Avail: NTIS HC A07/MF A01 CSCL 05B

The High resolution Imaging Spectrometer (HIRIS) is designed to acquire images simultaneously in 192 spectral bands in the 0.4 to 2.5 micrometers wavelength region. It will make possible the collection of essentially continuous reflectance spectra at a spectral resolution sufficient to extract significantly enhanced amounts of information from return signals as compared to existing systems. The advantages of such high dimensional data come at a cost of increased system and data complexity. For example, since the finer the spectral resolution, the higher the data rate, it becomes impractical to design the sensor to be operated continuously. It is essential to find new ways to preprocess the data which reduce the data rate while at the same time maintaining the information content of the high dimensional signal produced. Four spectral feature design techniques are developed from the Weighted Karhunen-Loeve Transforms: (1) non-overlapping band feature selection algorithm; (2) overlapping band feature selection algorithm; (3) Walsh function approach; and (4) infinite clipped optimal function approach. The infinite clipped optimal function approach is chosen since the features are easiest to find and their classification performance is the best. After the preprocessed data has been received at the ground station, canonical analysis is further used to find the best set of features under the criterion that maximal class separability is achieved. Both 100 dimensional vegetation data and 200 dimensional soil data were used to test the spectral feature design system. It was shown that the infinite clipped versions of the first 16 optimal features had excellent classification performance. The overall probability of correct classification is over 90 percent while providing for a reduced downlink data rate by a factor of 10. Author

N90-24665*# Purdue Univ., West Lafayette, IN. Lab. for Applications of Remote Sensing.
USE OF HIGH-DIMENSIONAL SPECTRAL DATA TO EVALUATE ORGANIC MATTER, REFLECTANCE RELATIONSHIPS IN SOILS
T. L. Henderson, M. F. Baumgardner, D. C. Coster, D. P. Franzmeier, and D. E. Stott 1990 166 p
(Grants NAGw-925; NAGw-1472)
(NASA-CR-186650; NAS 1.26:186650; LARS-TR-013090) Avail: NTIS HC A08/MF A01 CSCL 05B

Recent breakthroughs in remote sensing technology have led to the development of a spaceborne high spectral resolution imaging sensor, HIRIS, to be launched in the mid-1990s for observation of earth surface features. The effects of organic carbon content on soil reflectance over the spectral range of HIRIS, and to examine the contributions of humic and fulvic acid fractions to soil reflectance was evaluated. Organic matter from four Indiana agricultural soils was extracted, fractionated, and purified, and six individual components of each soil were isolated and prepared for spectral analysis. The four soils, ranging in organic carbon content from 0.99 percent, represented various combinations of genetic parameters such as parent material, age, drainage, and native vegetation. An experimental procedure was developed to measure reflectance of very small soil and organic component samples in the laboratory, simulating the spectral coverage and resolution of the HIRIS sensor. Reflectance in 210 narrow (10 nm) bands was measured using the CARY 17D spectrophotometer over the 400 to 2500 nm wavelength range. Reflectance data were analyzed statistically to determine the regions of the reflective spectrum which provided useful information about soil organic matter content and composition. Wavebands providing significant information about soil organic carbon content were located in all three major regions of the reflective spectrum: visible, near infrared, and middle infrared. The purified humic acid fractions of the four soils were separable in six bands in the 1600 to 2400 nm range, suggesting that longwave middle infrared reflectance may be useful as a non-destructive laboratory technique for humic acid characterization. Author

N90-24666# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. fuer Optische Fernerkundung.
MULTISPECTRAL CLASSIFICATION OF OVERLAPPING CLASSES WITH APPLICATIONS TO FOREST DAMAGE AREAS Ph.D. Thesis - Tech. Univ. Hanover
Peter Reinartz Jul. 1989 183 p In GERMAN; ENGLISH summary Original contains color illustrations
(DLR-FB-89-55; ISSN-0171-1342; ETN-90-96459) Avail: NTIS HC A09/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 74 DM

The multispectral classification of remotely sensed data was critically analyzed, and proposals are given for an optimization of supervised classifications. Quantitative separability measures were derived for the analysis of class differences. With these measures, criteria for the optimal selection of channels, training areas and classes can be determined, and artificial channels and radiometric correction algorithms can be quantitatively investigated. The developed methods were applied and tested for the classification of tree species and damages in airborne Thematic Mapper data acquired by the line scanner DAEDALUS ATM 1286. ESA

N90-24667# Beleidscommissie Remote Sensing, Delft (Netherlands).
THE APPLICATION OF REMOTE SENSING TECHNIQUES FOR REGIONAL PLANNING, ENVIRONMENTAL STUDIES, AND ENVIRONMENT MAINTENANCE [DE TOEPASSING VAN REMOTE SENSING TECHNIEKEN VOOR RUIMTELIJKE ORDENING, MILIEUONDERZOEK EN

MILIEUWETHANDHAVING]
Sep. 1989 29 p In DUTCH
(BCRS-89-16; ETN-90-96762) Avail: NTIS HC A03/MF A01

Some remote sensing applications which are important for the Dutch situation are presented. Remote sensing pictures from several years allow the establishement of land use maps, revealing changes in land use. Aerial pictures allow monitoring of all pollutions in a cheap and simple way. The interpretation of aerial pictures assists and complements historical studies. Remote sensing is very suited to track breaches of the environmental rules. ESA

N90-24668# Beleidscommissie Remote Sensing, Delft (Netherlands).
MODELLING AND SYNERGISM: OPTICAL AND MICROWAVE REMOTE SENSING. PARTIAL REPORT 1: PRELIMINARY STUDY [MODELVORMING EN SYNERGIE OPTISCHE EN MICROGOLF REMOTE SENSING. DEELRAPPORT 1: VOORSTUDIE]
J. G. P. W. Clevers and D. Hoekman Oct. 1989 87 p In DUTCH; ENGLISH summary
(BCRS-89-23; ETN-90-96787) Avail: NTIS HC A05/MF A01

Remote sensing models were further developed and tested, and the synergetic effect of combined observations in the optical and microwave domain on these models was investigated. In the optical domain CLAIR is a simple, semi-empirical user model for object parameter estimation. In the microwave domain CLOUD is a semi-empirical model to obtain information on biomass and plant water content; this model may be supported by more elaborated models. Due to the large amount of object parameters (vegetation and soil) the combination of optical and microwave measurements is needed to solve the inversion problem. It appears to be possible to construct a general model equation applicable to the red, near infrared, and microwave domain. ESA

N90-24669# Beleidscommissie Remote Sensing, Delft (Netherlands).
THE USE OF REMOTE SENSING FOR THE LOCALIZATION OF SEEPAGE NEAR THE TWENTHE CANAL, NETHERLANDS [GEBRUIK VAN REMOTE SENSING BIJ HET LOCALISIREN VAN KWEL NABIJ HET TWENTHEKANAAL]
A. M. vanLieshout Nov. 1989 74 p In DUTCH
(BCRS-89-30; ICW-Note-1924; ETN-90-96788) Avail: NTIS HC A04/MF A01

The occurence of seepage during the enlargement activities at the Twenthe canal (Netherlands) was investigated. The remote sensing pictures of the Spring reference situation are discussed; the instant at which the picture is taken and the use of false color pictures are very important. A simple simulation model was developed to understand the thermal behavior of the soil for different water tables. Recommendations for the use of remote sensing pictures are given with a view to the localization of seepage. ESA

N90-24670# Beleidscommissie Remote Sensing, Delft (Netherlands).
THE USE OF SATELLITE PICTURES OF THE YSSELMEER REGION (NETHERLANDS). OPTIMIZATION OF THE USE OF LANDSAT FOR WATER QUALITY APPLICATIONS IN THE YSSELMEER REGION [GEBRUIK VAN SATELLIETBEELDEN IN HET IJSSELMEERGERIED. OPERATIONALISERING GEBRUIK LANDSAT VOOR WATERKWALITEITSTOEPASSINGEN IN HET IJSSELMEERGEBIED]
H. Buiteveld, C. Meulstee, and H. Bakker (Rijkswaterstaat, The Hague, Netherlands) Dec. 1989 22 p In DUTCH Original contains color illustrations
(BCRS-89-31; ETN-90-96789) Avail: NTIS HC A03/MF A01

A method to convert LANDSAT pictures into pictures of water quality parameters was optimized. Concentration pictures can be provided for the following parameters: suspended sediments, bloom, chlorophylls and pheophytin, and Secchi depth. An important advantage of satellite concentration pictures is the complete spatial picture. Possible applications of concentration pictures are discussed. The additional costs due to the use of satellite pictures are acceptable. Recommendations for the implementation of the method in the monitoring program of the Ysselmeer region (Netherlands) are given. ESA

N90-24671# Ecole Nationale Superieure des Telecommunications, Paris (France). Groupe Image.
ON THE G1 SMOOTH CONNECTION BETWEEN TRIANGULAR BERNSTEIN-BEZIER PATCHES. PART 1: AROUND AND N-PATCH CORNER
Wen-Hui Du and Francis J. M. Schmitt Oct. 1989 41 p
(Telecom-Paris-89-D-012; ISSN-0751-1345; ETN-90-96955)
Avail: NTIS HC A03/MF A01

The use of triangular patches in surface representation is discussed. The technique allows for a smooth representation of surfaces with any topology. The Bernstein-Bezier triangular surface model is described. To create a model of a smooth surface, the geometric continuity between the triangular patches must be carefully organized. The connection between adjacent patches and in particular, the connection between any N number of patches sharing a corner in common, is investigated. It is shown that the constraints involved can be decomposed into two subsets which are simpler to solve. ESA

N90-24672# Ecole Nationale Superieure des Telecommunications, Paris (France). Groupe Image.
ON THE G1 SMOOTH CONNECTION BETWEEN TRIANGULAR BERNSTEIN-BEZIER PATCHES. PART 2: IN A PIECEWISE REPRESENTATION
Wen-Hui Du and Francis J. M. Schmitt Oct. 1989 27 p
(Telecom-Paris-89-D-013; ISSN-0750-1345; ETN-90-96956)
Avail: NTIS HC A03/MF A01

The piecewise representation of free form G1 continuous surfaces using triangular Bernstein-Bezier (tBB) patches is described. Several approaches are proposed. A triangular patch model is developed which allows for a simple G1 smooth connection between adjacent patches and offers an attractive solution to free form surface modeling. The advantages of the triangular patch method over other methods are described. Photographs showing triangular patch representation of three dimensional models are presented. ESA

N90-24673# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Image.
FREE-FORM SURFACE MODELLING USING TENSOR PRODUCT BEZIER PATCHES: A REVIEW WITH NEW SOLUTIONS
Wen-Hui Du and Francis J. M. Scmitt Oct. 1989 48 p
(Telecom-Paris-89-D-014; ISSN-0751-1345; ETN-90-96957)
Avail: NTIS HC A03/MF A01

Research carried out to ensure smooth connection between adjacent Bezier patches is summarized. The techniques used in free form surface modeling using Bezier patches are reviewed. Alternative approaches for modeling any G1 continuous surface are presented. The methodology developed in studying continuity control around an N-patch corner is described. The use of this methodology as a tool with which to design one's own free form surface modeling method is discussed. The use of this tool in investigating other types of smooth connection problems is described. ESA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N90-24674# Midwest Research Inst., Golden, CO.
SOLAR THERMAL PROGRAM SUMMARY. VOLUME 2: RESEARCH SUMMARIES Report, Fiscal Year 1989
Jan. 1990 69 p
(Contract DE-AC02-83CH-10093)
(DE89-009476; DOE/CH-10093/61-Vol-2) Avail: NTIS HC A04/MF A01

The Federal government has conducted the National Solar Thermal Technology Program since 1975. Its purpose is to provide focus, direction, and funding for the development of solar thermal technology as an energy option for the United States. More than a decade of research and development has brought solar thermal systems to a point where they have proven useful for generating electricity and process heat. Improvements to these during the 1980s led to reductions in capital and energy costs of 80 percent. Parabolic trough systems are now considered technically mature and are being used in the world's largest solar electric systems, generating electricity for less than $0.12/kWh. Central receiver and dish technologies have also been demonstrated in several plants throughout the world. The cost of concentrators, the largest cost component of solar thermal systems, has dropped from $900 to $1300/sq m in 1978 to $70 to $16/sq m today, while performance has improved significantly. Solar thermal technology has also shown strong potential for advanced applications, such as destroying hazardous wastes and processing materials and chemicals. This annual summary provides an overview of the government-funded activities within the National Solar Thermal Technology Program. Tasks conducted in house by the participating national laboratories or under contract to industry and academic and other research institutions are highlighted. This document covers those activities initiated, renewed, or completed during FY 1989. DOE

N90-24675*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DIRECT CONVERSION TECHNOLOGY Annual Summary Report, 1989
Paul F. Massier, C. P. Bankston, R. Williams, M. Underwood, B. Jeffries-Nakamura, and G. Fabris Dec. 1989 56 p Sponsored by NASA, Washington
(Contract DE-AI01-86CE-90237)
(NASA-CR-186795; NAS 1.26:186795; DE90-010057; JPL-D-6846) Avail: NTIS HC A04/MF A01 CSCL 10A

The overall objective of the Direct Conversion Technology task is to develop an experimentally verified technology base for promising direct conversion systems that have potential application for energy conservation in the end-use sectors. This report contains progress of research on the Alkali Metal Thermal-to-Electric Converter (AMTEC), and on the Two-Phase Liquid-Metal Magnetohydrodynamic Electrical Generator (LMMHD) for the period January 1, 1989 through December 31, 1989. Research on these concepts was initiated during October 1987. Reports prepared on previous occasions contain discussions on the following other direct conversion concepts: thermoelectric, pyroelectric, thermionic, thermophotovoltaic, thermoacoustic, thermomagnetic, thermo-elastic (nitinol heat engines); and also, more complete discussions of AMTEC and LMMHD systems. DOE

N90-24676# Technische Univ., Eindhoven (Netherlands).
DYNAMIC OPTIMISATION OF THERMAL ENERGY SYSTEMS Ph.D. Thesis
Alexander George Emi vanDelft 1989 185 p
(ETN-90-96900) Avail: NTIS HC A09/MF A01

The dynamical behavior of the components of the thermal energy processes considered are described with mathematical models. Dynamic optimal control is achieved by a dedicated optimization method. The method was developed and is described. By means of a number of representative optimization results obtained for different conditions it is indicated how dynamic optimization leads to a better designed and controlled process. The sensitivity of the optimal control to variations in the disturbance patterns is studied, together with adaptation techniques which can be used to approach optimal control in practical situations. A design procedure for thermal energy systems results, in which the control aspects are taken into account systematically, the final result being a system with better chosen dimensions and control. ESA

N90-24677# Midwest Research Inst., Golden, CO.
OCEAN ENERGY PROGRAM SUMMARY. VOLUME 2: RESEARCH SUMMARIES Report, Fiscal Year 1989
Jan. 1990 33 p
(Contract DE-AC02-83CH-10093)
(DE89-009482; DOE/CH-10093/67-Vol-2) Avail: NTIS HC A03/MF A01

The oceans are the world's largest solar energy collector and storage system. Covering 71 percent of the earth's surface, this stored energy is realized as waves, currents, and thermal salinity gradients. The purpose of the Federal Ocean Energy Technology (OET) Program is to develop techniques that harness this ocean energy in a cost effective and environmentally acceptable manner. The OET Program seeks to develop ocean energy technology to a point where the commercial sector can assess whether applications of the technology are viable energy conversion alternatives or supplements to systems. Past studies conducted by the U.S. Department of Energy (DOE) have identified ocean thermal energy conversion (OTEC) as the largest potential contributor to United States energy supplies from the ocean resource. As a result, the OET Program concentrates on research to advance OTEC technology. Current program emphasis has shifted to open-cycle OTEC power system research because the closed-cycle OTEC system is at a more advanced stage of development and has already attracted industrial interest. During FY 1989, the OET Program focused primarily on the technical uncertainties associated with near-shore open-cycle OTEC systems ranging in size from 2 to 15 MW(sub e). Activities were performed under three major program elements: thermodynamic research and analysis, experimental verification and testing, and materials and structures research. These efforts addressed a variety of technical problems whose resolution is crucial to demonstrating the viability of open-cycle OTEC technology. This publications is one of a series of documents on the Renewable Energy programs sponsored by the U.S. Department of Energy. An overview of all the programs is available, entitled Programs in Renewable Energy. DOE

N90-24678# Midwest Research Inst., Golden, CO.
BIOFUELS PROGRAM SUMMARY. VOLUME 2: RESEARCH SUMMARIES Report, Fiscal Year 1989
Jan. 1990 240 p
(Contract DE-AC02-83CH-10093)
(DE89-009484; DOE/CH-10093/69-Vol-2) Avail: NTIS HC A11/MF A02

The Federal government has supported research on biomass technology and energy from municipal waste since 1975. Separate research programs were conducted until 1985 when the two were merged into biofuels and municipal waste technology to take advantage of their many similarities in conversion requirements and research needs. The purpose of the biofuels program is to provide focus, direction, coordination, and funding for the development of technologies that produce tailored energy crops and convert these crops and wastes to fuels. The FY 1989 program includes research on the production (growth) of biomass and its conversion to fuels. Research on biomass production involves the development and use of genetically improved trees and grasses specifically for their energy conversion characteristics (terrestrial energy crops). The Biofuels Program Summary is prepared each year and consists of a two-volume reference set describing the

technological advances, current projects, and future research and development (R and D) directions of the program. This volume (Volume 2-Research Summaries) is a compilation of detailed descriptions of the R and D projects performed by the national laboratories and their subcontractors from industry, universities, and nonprofit research institutions. DOE

N90-24679# Sandia National Labs., Albuquerque, NM.
A DIRECT ABSORBER REACTOR/RECEIVER FOR SOLAR THERMAL APPLICATIONS
R. E. Hogan, Jr., R. D. Skocypec, R. B. Diver, J. D. Fish, M. Garrait, and J. T. Richardson (Houston Univ., TX.) 1990 19 p Presented at the 11th International Symposium on Chemical Reaction Engineering, Toronto, Ontario, 8-11 Jul. 1990
(Contract DE-AC04-76DP-00789)
(DE90-006280; SAND-89-3086C; CONF-900703-1) Avail: NTIS HC A03/MF A01

A novel catalytic reactor concept is described in which concentrated radiant (solar) energy is directly absorbed at the catalytic reaction sites, thereby avoiding the heat transfer limitations of conventional tubular reactors for high flux conditions. Results from a detailed numerical model of a direct catalytic absorption reactor illustrate unique features of the reactor and critical design requirements of the volumetric absorber. Numerical predictions compare well with preliminary experimental data for carbon dioxide reforming of methane to synthesis gas. Thermal and chemical conditions of the absorber for a large scale reactor under typical high flux operation are shown. DOE

N90-24680# Department of Energy, Washington, DC. Office of Program Analysis.
SUMMARY RESULTS OF AN ASSESSMENT OF RESEARCH PROJECTS IN THE NATIONAL PHOTOVOLTAICS PROGRAM
Mar. 1990 8 p
(DE90-008222; DOE/ER-0443) Avail: NTIS HC A02/MF A01

The Photovoltaics Technology Division of the Department of Energy (DOE) is responsible for the management of the National Photovoltaics (PV) Program. This program sponsors research and development in photovoltaics energy technology. The program is designed to facilitate accumulation of a base of scientific and technical data and experience from which private enterprise can choose options for further development and competitive application in electrical markets in the United States. At request of the Director, Photovoltaics Technology Division, the Office Program Analysis (OPA) undertook an assessment of 129 projects managed by his Division. The primary objective of the assessment was to obtain a measure of the quality of the research or development in each project. Each panel consisted of five to eight scientific or technical reviewers collectively knowledgeable in all of the photovoltaics energy technology areas touched on by the projects being assessed. The purpose of this assessment was to obtain sufficient information for DOE managers to determine the following: what quality research sponsored by the Photovoltaics Technology Division, is represented by its individual projects; what the impact of individual projects is within the Photovoltaic Technology Division on the mission of Solar Renewables; and what the priority research targets and opportunities for future sponsorship are. DOE

N90-24681# Midwest Research Inst., Golden, CO.
PHOTOVOLTAIC MEASUREMENTS AND PERFORMANCE BRANCH Annual Report, FY 1989
S. E. Asher, ed. and P. Dippo, ed. May 1990 214 p
(Contract DE-AC02-83CH-10093)
(DE90-000324; SERI/TP-213-3712) Avail: NTIS HC A10/MF A02

The Photovoltaic (PV) Measurements and Performance Branch of the Solar Energy Research Institute (SERI) provides comprehensive PV materials, device and component characterization, measurement, fabrication, and modeling research and support for the international PV research community in the context of the U.S. Department of Energy's PV m goals. The progress of the Branch is summarized. The seven technical sections present a succinct overview of the capabilities and accomplishments of each group in the Branch. The Branch is comprised of the following groups; Surface and Interface Analysis, Materials Characterization, Device Development, Electro-Optical Characterization, Cell Performance, Advanced Module Testing and Performance, and Surface and Interface Modification and Stability. The main research projects completed in FY 1989 are highlighted including measurements and tests of PV materials, cells, submodules and modules. The report contains a comprehensive bibliography of the more than 80 branch-originated journal and conference publications which were authored in collaboration with, or in support of, approximately 130 university, industrial, government, and in-house research groups. DOE

N90-24682# Midwest Research Inst., Golden, CO.
SERI PHOTOVOLTAIC SUBCONTRACT REPORTS: 1989 ABSTRACTS AND DOCUMENT CONTROL INFORMATION, MARCH 1, 1987 TO FEBRUARY 29, 1988
S. Guha Apr. 1990 55 p
(Contract DE-AC02-83CH-10093)
(DE90-000336; SERI/TP-211-3678) Avail: NTIS HC A04/MF A01

Document control information and abstracts for SERI Photovoltaic (PV) Program Branch publications resulting from SERI's subcontracted PV research is presented. The information is presented for reports published and distributed during fiscal year (FY) 1989. In the past, copies of the subcontractor reports were distributed to a broad spectrum of researchers in the field of photovoltaics at a considerable cost to the program. In an attempt to reduce costs and ensure that all researchers receive those current publications that are of specific interest to them, these publications are outlined and organized by technology, on a regular basis. Subsequent reports are expected to be distributed quarterly. A list of additional publications and sources is included herein to provide the photovoltaic community with other sources of information. DOE

N90-24683# Sandia National Labs., Albuquerque, NM.
DEVELOPMENT OF A POINT-CONTACT SOLAR CELL USING HIGH-VOLUME PROCESSING TECHNIQUES
Gary E. Miner, Lee A. Christel, J. Thomas Merchant, and Jerry S. Olson Apr. 1990 63 p Prepared in cooperation with SERA Solar Corp., Santa Clara, CA
(Contract DE-AC04-76DP-00789)
(DE90-010330; SAND-89-7045) Avail: NTIS HC A04/MF A01

Point-contact solar cells have achieved the highest efficiencies recorded to date for silicon cells, reaching 28.2 percent at 10 watts/sq cm. Though this technology offers several advantages over conventional bifacial cells, special process techniques are needed to optimize performance. Point-contact cells require a thin base, high bulk lifetime, low surface recombination velocities, effective light trapping, and effective heat sinking. These requirements were addressed in the development of a high efficiency cell process using high volume, integrated circuit process equipment. Two methods developed for producing thin cells were compared in yield and manufacturability. Techniques were developed for processing thin cells using automated production equipment. The fabrication process was designed to minimize lifetime degradation. Minority carrier lifetime data are presented for a full range of process steps. Three optical textures were compared in an experimental light-trapping study. These process techniques were combined to produce several types of cells. The best has achieved an efficiency of 25.0 percent at 87 suns. DOE

N90-24684# Sandia National Labs., Albuquerque, NM.
PHOTOVOLTAIC CONCENTRATOR TECHNOLOGY DEVELOPMENT
E. C. Boes 1990 8 p Presented at the 21st IEEE Photovoltaic Specialists Conference, Kissimmee, FL, 21-25 May 1990
(Contract DE-AC04-76DP-00789)
(DE90-011479; SAND-89-2454C; CONF-900542-6) Avail: NTIS HC A02/MF A01

The progress made in the past 18 months in the area of

photovoltaic concentrator technology development is summarized. A brief description of the status of two new photovoltaic concentrator power systems, the 300 kW ENTECH-3M-Austin system, and the single-pedestal Alpha Solarco system is given. Considerable progress in the area of photovoltaic concentrator module development is reported. The module development acitivities are emphasized that have resulted in significantly higher conversion efficiencies or new module design concepts. Included is a brief discussion of the major gains in concentrator cell efficiencies, especially the increased efficiencies for multijunction cells, and their implications for the technology. Also, discussed are the most significant recent developments for PV concentrator components, including refractive secondary optical elements and a self-contained, electronic, array-tracking controller. Finally, the outlook for markets and sales for photovoltaic concentrators is discussed and a new program in the United States, the Photovoltaic Concentrator Initiative is briefly discussed. DOE

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N90-24685 Deutscher Wetterdienst, Offenbach am Main (Germany, F.R.).
REPORTS FROM THE GERMAN METEOROLOGICAL SERVICE. NO. 179: DEVELOPMENT, REALIZATION AND FUNCTIONING OF LIDAR TO EVALUATE THE ATMOSPHERIC OZONE PROFILE [BERICHTE DES DEUTSCHEN WETTERDIENSTES NR. 179: WEITERENTWICKLUNG, BAU UND BETRIEB EINES LIDARS ZUR BESTIMMUNG DES ATMOSPHAERISCHEN OZONPROFILS]
Hans Claude, Bernd Geh, Reinhold Hartmannsgruber, Thomas Hohmann, Karl Werner Rothe, Fritz Schoenenborn, Herbert Walther (Technische Univ., Munich, Germany, F.R.), and Klaus Wege 1989 78 p In GERMAN; ENGLISH summary Sponsored by BMFT
(ISBN-3-88148-252-0; ISSN-0072-4130; ETN-90-96478)
Copyright Avail: Deutscher Wetterdienst, Frankfurter Strasse 135, D-6050 Offenbach am Main, Fed. Republic of Germany

The vertical ozone distribution is measured up to 50 km altitude by means of a lidar system that allows the observation of areas of the upper stratosphere where a strong depletion is predicted by calculations and which cannot be reached by regular ozone soundings. The experimental device was based on a pulsed Xe-Cl excimer laser, which was equipped with an unstable resonator. The pulse energy is controlled by an intelligent laser control unit. The results are compared with those of balloon sondes and spectrophotometers. A very good agreement between all these systems be observed. ESA

N90-24686*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
FIELD EVALUATION OF A PASSIVE SAMPLING DEVICE FOR HYDRAZINES IN AMBIENT AIR
P. A. Taffe, S. W. Brown, A. R. Thurow, J. C. Travis, S. L. Rose-Pehrsson, and J. R. Wyatt (Naval Research Lab., Washington, DC.) 6 Apr. 1990 93 p
(NASA-TM-103456; NAS 1.15:103456; AD-A221074; NRL-MR-6613) Avail: NTIS HC A05/MF A01 CSCL 13/2

A passive sample-dosimeter has been developed for evaluating part-per billion (ppb) levels of hydrazine and monomethyl hydrazine (MMH) in ambient air. It is designed for quantitative documentation of personnel exposures as well as ambient atmosphere concentration. It has undergone extensive laboratory and field evaluations. The laboratory tests are reviewed in this report. Tests were conducted in controlled atmospheres to evaluate the following performance parameters: collection rate, face velocity, relative humidity effects, sample stability, reproducibility, linearity, and interference effects of selected chemical vapors. Field tests were conducted to evaluate performance under typical anticipated conditions. The test locations were selected to provide information on the probable interferents. A double-bind protocol was used which involved three groups: industrial hygienists; analytical chemists; and auditors. The data obtained from the field evaluation disclosed a performance problem not encountered in the laboratory. The cause was identified and the prototype system was modified and re-tested. The results from the modified sampler indicate that it is suitable for work place monitoring applications with two minor interferents: tobacco smoke and intense direct sunlight. GRA

N90-24687# Woods Hole Oceanographic Inst., MA.
EFFECTS OF SOLAR ULTRAVIOLET RADIATION ON BIOGEOCHEMICAL DYNAMICS IN AQUATIC ENVIRONMENTS
N. V. Blough, ed. and R. G. Zepp, ed. Jan. 1990 201 p Workshop held in Woods Hole, MA, 23-26 Oct. 1989
(Contracts N00014-90-J-1154; EPA-CR-816171-01-0)
(AD-A221119; WHOI-90-09) Avail: NTIS HC A10/MF A02 CSCL 08/1

The changes in ground-level UV radiation that accompany changing cloud cover and stratospheric ozone levels may have serious consequence for numerous biological and geochemical cycles that are critically important to the well-being of the biosphere. Moreover, because carbon dioxide, nitrous oxide, methane, halocarbons, carbon monoxide and carbonyl sulfide all have natural sources and sinks in the biosphere, alterations of the biogeochemical cycles could introduce significant positive or negative feedbacks to the atmospheric concentrations of these important trace gases. To better assess the possible ramifications of changing UV levels on biogeochemical dynamics, this workshop assembled a diverse group of experts, including atmospheric chemists and physicists and aquatic chemists, biochemists and biologists. Participants were asked to help identify and more clearly define: (1) the potential effects of climate change on ground level solar UV (and visible) radiation, (2) the impacts of solar UV radiation on geochemical processes in aquatic systems, (3) the effects of solar UV radiation on biological processes, with emphasis on the possible effects of enhanced UV-B (280 to 320 nm) radiation. Participants were asked to discuss experimental and theoretical approaches to better characterize and model these processes on both regional and global scales. GRA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N90-24688# National Oceanic and Atmospheric Administration, Washington, DC. Atmospheric Sciences Branch.
IMPLEMENTATION OF REFLECTANCE MODELS IN OPERATIONAL AVHRR RADIATION BUDGET PROCESSING
V. Ray Taylor Feb. 1990 38 p
(NOAA-TR-NESDIS-49) Avail: NTIS HC A03/MF A01

A major parameter in calculating the Earth's radiation budget is reflection by the illuminated Earth-atmosphere system. Data from Advanced Very High Resolution Radiometer (AVHRR) instruments on the NOAA satellite series have long been used to derive reflected radiation budget parameters. However, the accuracy of such estimates from narrow-band instruments has been challenged because of inaccurate assumptions. To derive reliable reflectance parameters from AVHRR, one must, in an operational environment, convert an instantaneous, highly directional, narrowband radiation measurement into an estimate of daily average broadband flux over the whole upward hemisphere. This conversion is accomplished by applying models of the following types: bi-directional; directional; narrow to broadband; and scene type identification. The implementation of these reflectance models into the operational environment is described, the events that occurred when shortwave reflected data was processed are traced, and output parameters with and without reflectance models are compared. A processing system which will allow research of

AVHRR radiation budget processing in a true off-line mode which will not affect, nor be affected by the on-going operation is being developed. M.G.

N90-24689 California Univ., Berkeley.
THE COMPOSITION AND PHYSICAL PROPERTIES OF THE EARTH'S MANTLE AND CORE Ph.D. Thesis
Elise Barbara Knittle 1989 126 p
Avail: Univ. Microfilms Order No. DA9006395

The chemical and physical properties of the Earth's deep interior, particularly the mantle and core, have controlled both the dynamics and the evolution of the planet. Although seismic studies are the primary observational means of characterizing the deep interior, such studies are only capable of determining the velocity of seismic waves and, in an average sense, densities at depth. The physical interpretation of seismic results relies on understanding the properties of materials likely to be present within the mantle and core. The experiments allow comparisons to be made between high pressure experiments and corresponding seismological observations, providing insight into the Earth's large-scale chemical structure. Electrical resistivity measurements to pressures of 83 GPa and temperatures ranging from 300 K to 4300 K confirm the presence of both crystalline and liquid metallic phases of FeO at pressures above 60 to 70 GPa and temperatures above 1000 K. By experimentally determining the melting temperature of FeO to 100 GPa, and of a model core composition at 83 GPa, it was found that the solid-melt equilibria can be described by complete solid solution across the Fe-FeO system at pressures above 70 GPa. The data suggest that the temperature at the Earth's core-mantle boundary is close to 4800 (+ or - 500) K. The thermal expansion of silicate perovskite, the most abundant in the Earth's lower mantle, was measured between 300 and 840 K at zero pressure. These data are combined with the 300 K isotherm of silicate perovskite, measured to pressures of 112 GPa, to obtain a thermal equation of state for this mineral. The thermal equation of state allows comparisons to be made between the physical properties of silicate perovskite and mineral assemblages dominated by perovskite with the same properties for lower mantle as determined by seismology. Chemical reactions between silicate perovskite and liquid iron were documented at pressures greater than 70 GPa using the laser heated diamond anvil cell. Dissert. Abstr.

N90-24690 Columbia Univ., New York, NY.
HEAT AND FLUID FLOW WITHIN THE EARTH'S CRUST: IN SITU MEASUREMENTS AND MATHEMATICAL MODELS Ph.D. Thesis
Colin Francis Williams 1989 215 p
Avail: Univ. Microfilms Order No. DA9005959

A mathematical model was developed to study the effects of hydrothermal circulation on heat flow along the San Andreas fault. Frictional heating should generate a fault-centered heat flow anomaly of approximately 40 mW/sq m, but field studies have failed to resolve any measurable anomaly. The long-strike elevation of the fault zone suggests that gravity-induced fluid flow may be attenuating the expected anomaly. Lateral variations in topography and permeability may account for the scatter of measured heat flow values. During ODP Leg 116, three sites were drilled in the Indian Ocean intraplate deformation region. Heat flow within underformed sediments matches the 52 mW/sq m predicted for 78 Ma crust. Heat flow near a buried thrust fault averages 84 mW/sq m and reflects the presence of hydrothermal circulation. The nature and magnitude of this hydrothermal flow was modeled. If the oceanic basement is permeable, fluid flow within the basement and upward along the thrust fault provides a match to the observed heat flow. Knowledge of the variation of thermal conductivity and heat production with depth is critical to understanding the thermal state of the crust. Models which relate thermal properties to physical and chemical properties were developed and calibrated with data from deep drillholes. The use of geochemical log-derived mineralogy in a model for the thermal conductivity of an isotropic crystalline aggregate was successful. However, mineralogy-based models do not account for the anisotropic conductivity of foliated rocks. A phonon conduction model, which estimates conductivity from velocity and density measurements, is accurate to + or - 15 percent in both isotropic and anisotropic formations. Well log radioelement data indicate that heat production can only be predicted from rock compositional data within a factor of 2 or 3 and from velocity and density measurements within an order of magnitude. Three factors account for this: the variability of velocity and density for a given composition, the association of U and Th with secondary minerals, and U and Th redistribution through fluid flow and metamorphism. Dissert. Abstr.

N90-24691 California Univ., Los Angeles.
A NUMERICAL INVESTIGATION OF THERMAL CONVECTION IN HIGHLY VISCOUS SPHERICAL SHELLS WITH APPLICATIONS TO MANTLE DYNAMICS IN THE EARTH AND OTHER TERRESTRIAL PLANETS Ph.D. Thesis
David Anthony Bercovici 1989 398 p
Avail: Univ. Microfilms Order No. DA9008109

Numerical models of thermal convection in highly viscous spherical shells are used to investigate mantle convection in the Earth, Mars and Venus. Three-dimensional Boussinesq and compressible convection in basally heated shells are examined for different convective patterns. The influences of heating mode and mechanical boundary conditions are investigated. Three-dimensional models of Boussinesq convection for basal heating show that two polyhedral convective patterns predicted by perturbation theory are stable up to Rayleigh numbers Ra (a measure of convective vigor) or the order 100 Ra(sub cr) Ra(sub cr is the critical Ra for the the onset of convection). The stability of these patterns to flow reversal is tested for several Ra. Compressibility has its greatest effect when superadiabatic temperature drop delta T(sub ea) is small. An analysis of axisymmetric convection with either basal or internal heating indicates that dynamic topography and convection cell wavelength increase across bifurcations with increasing Ra. For a wide range of heating modes, three-dimensional convection displays downwelling in planar sheets, and upwelling in cylindrical plumes. The imposition of a rigid upper boundary on three-dimensional models of convection (with applications to the mantles of Mars and Venus) makes downwelling regions irregularly structured and short-lived and causes the upper boundary layer around upwelling plumes to be interspersed with narrow downwelling regions emanating radially from the plumes' axes. The dependence of convection cell wavelength on heating mode and core size implies that large scale geologic features may have originated during core formation. Dynamic topography for the Mars models is comparable to Tharsis topography. Dissert. Abstr.

N90-24692# Research Inst. of National Defence, Linkoeping (Sweden). Dept. of Information Technology.
ATMOSPHERIC SOUNDING WITH UV LIDAR
Arne Haagaard Oct. 1989 35 p In SWEDISH; ENGLISH summary
(FOA-C-30542-3.1; ISSN-0347-3708; ETN-90-96585) Avail: NTIS HC A03/MF A01; Research Inst. of National Defence, Box 1165, S-581 11 Linkoeping, Sweden, 50 Swedish crowns

An optimal radar system with YAG laser for atmospheric sounding is described. The third harmonic of the laser at 355 nm and the fourth at 266 nm are used in the main. Thereby the optical radar is relatively safe and the safety distance for eye damage is low. Methods for visibility measurement and humidity sounding were developed. Raman spectra are used for humidity sounding in daylight. Experiments and results are described. ESA

N90-24693# Swedish Defence Research Establishment, Umea.
THE GIT MODEL: AN ATMOSPHERIC BOUNDARY LAYER MODEL ALONG A TRAJECTORY
Edvard Karlsson Nov. 1989 20 p In SWEDISH; ENGLISH summary
(FOA-E-40039-3.2; ISSN-0281-9945; ETN-90-96590) Avail: NTIS

HC A03/MF A01; Swedish Defence Research Establishment, S-901 82 Umeaa, Sweden, 50 Swedish crowns

A one dimensional atmospheric boundary layer model, coupled to an horizontal trajectory in order to describe the horizontal advection, was used for several years at some sites in the weather service. The model gives prediction of temperature, humidity, fog, and stratus clouds, but can also be used for diagnosis of the refractivity and radar duct conditions. A physical description of the GIT model is given. In the previous model long wavelengths, due to clouds and mist, were not taken into account. With the GIT model, this radiation, up to a height of 11,000 m, is considered. ESA

N90-24694# Goettingen Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftlichen Fachbereich.
ION NEUTRAL GAS COUPLING IN THE POLAR ATMOSPHERE: USE OF EISCAT FOR THE CALCULATION OF THERMOSPHERIC PARAMETERS Ph.D. Thesis [IONEN-NEUTRALGAS-KOPPLUNG IN DER POLAREN ATMOSPHAERE: BENUTZUNG VON EISCAT FUER DIE BERECHNUNG VON THERMOSPHAERISCHEN PARAMETERN]
Dante R. FigueroaMartinez 1988 93 p In GERMAN Sponsored by Deutschen Akademischen Austauschienstes; Max-Plank-Gesellschaft; and Universidad de Conception, Chile
(ETN-90-96490) Avail: NTIS HC A05/MF A01

Data collected by the method of incoherent retrodiffusion about the electrically charged particles of the ionosphere was used for derivation of the parameters of the neutral gas, whose temperature and velocity was deduced from energy and impulse equations. The DTM (Drag Temperature Model) model was used to obtain a better evaluation of the calculated values. Measurements were achieved with a Fabry-Perot interferometer and showed that by a high magnetic parasitic degree a strong coupling exists between ions and neutral gas. ESA

N90-24695# Karlsruhe Univ. (Germany, F.R.).
THE GAUSS BEAM METHOD FOR SURFACE WAVES. THEORY AND UTILIZATION FOR A LATERAL HETEROGENEOUS SPHERIC EARTH Ph.D. Thesis [DIE GAUSS-BEAM METHODE FUER OBERFLAECHENWELLEN. THEORIE UND ANWENDUNGEN FUER EINE LATERAL HETEROGENE, SPHAERISCHE ERDE]
Wolfgang Friedrich 1988 125 p In GERMAN; ENGLISH summary
(ETN-90-96492) Avail: NTIS HC A06/MF A01

To describe a Gaussian beam on a sphere, a new ray-centered coordinate system is created to transform the elastodynamic equation. A high frequency approximation was applied and parabolic differential equations were obtained by combination of a perturbation term and the theory of free oscillations. Their solution leads to a new dynamic ray tracing system valid on a sphere. By comparison with an exact solution for a laterally homogeneous medium, weight functions were derived, which allowed the synthesis of the displacement field by the superposition of Gaussian beams. A study of the effects of the lateral heterogeneities on the propagation of surface waves revealed considerable path anomalies, polarization and amplitude anomalies. A travel time analysis particularly showed the failure of the pure path approximation. ESA

N90-24696# Colorado Univ., Boulder. Dept. of Chemistry and Biochemistry.
IR TRANSITION MOMENTS AND COLLISIONAL DYNAMICS OF VIBRATIONALLY EXCITED OH RADICALS VIA TIME-RESOLVED LASER ABSORPTION SPECTROSCOPY Final Report, 1986 - 1989
David J. Nesbitt 30 Mar. 1990 19 p
(Contract F49620-86-C-0056; AF Proj. 2303)
(AD-A221005; AFOSR-90-0514TR) Avail: NTIS HC A03/MF A01 CSCL 04/1

A high resolution, IR laser flash kinetic spectrometer has been constructed for time-resolved study of reactive kinetics, energy transfer, and radiative properties of atmospheric OH radicals. Theoretical efforts predict a dramatic J dependence to OH vibrational radiative rates, which are exploited experimentally in the flash kinetic spectrometer to infer an empirical dipole moment function. The accuracy of this dipole moment function is extended to include the turning points of up to OH(v=9) by use of rotationally resolved emission from FTIR studies of the H + O3 chemiluminescent reaction. The explicit knowledge of the state-to-state radiative rates permits an absolute measurement of the quantum yields for 193 and 248 nm photolysis production of OH from HNO3 and H2O2. Reaction rates of OH with atmospheric hydrocarbons are investigated, as well as the relaxation processes of highly rotationally excited OH formed by excimer laser photolysis of HNO3. This information bears directly on the characterization of highly vibrationally and rotationally excited OH airglow emission from the stratosphere. GRA

N90-24697# RADEX, Inc., Bedford, MA.
MODELS OF THE EXTERNAL SOURCE CONTRIBUTION TO MAGNETOSPHERIC MAGNETIC FIELDS FOR CRRES DATA ANALYSIS Scientific Report No. 2, Jun. 1989 - Jan. 1990
J. N. Bass and C. E. Jordan 31 Jan. 1990 47 p
(Contract F19628-89-C-0068; AF Proj. 7659)
(AD-A221059; RX-R-90011; GL-TR-90-0009; SR-2) Avail: NTIS HC A03/MF A01 CSCL 04/1

The Olson-Pfitzer tilt dependent, the Mead-Fairfield, the Tsyganenko-Usmanov, the Tsyganenko 1987, the Olson-Pfitzer dynamic, and the Stern external magnetic field models are reviewed for their appropriateness for use in analysis of data from the Combined Release and Radiation Effects Satellite (CRRES). Descriptions of the models and their derivations are given. The Stern model requires considerably more computation time than the others. The L-parameter computed with an internal plus external field deviates considerably from that obtained with the internal field alone at the larger radial distances in CRRES's range. The models also differ noticeably from one another. The magnetic field magnitudes computed from the models during a SCATHA orbit over a magnetically quiet period agree well with SCATHA magnetometer observations. The Olson-Pfitzer dynamic model best tracks the data. However during the subsequent orbit, none of the models depict the large observed substorm- associated depression. The equatorial midnight field depression predicted by the Olson-Pfitzer dynamic model at zero dipole tilt is larger at small distances than that implied by averaged AMPTE and OGO measurements; the Stern and Olson-Pfitzer tilt dependent models are in good agreement with the measurements, while the other models predict smaller depressions. GRA

N90-24698# Air Force Geophysics Lab., Hanscom AFB, MA.
CURRENT STATUS OF SHARC, THE STRATEGIC HIGH ALTITUDE RADIANCE CODE, AND DESCRIPTION OF ITS NEW AURORAL MODULE
Ramesh Sharma, Anthony Ratkowski, James Duff, Lawrence Bernstein, John Gruninger, Robert Sundberg, David Robertson, and Rebecca Healey (Yap Analytics, Inc., Lexington, MA.) 20 Apr. 1990 14 p In Presentation at an IRIS Meeting (Monterey, CA), Jan. 1990
(AF Proj. S321)
(AD-A221068; GL-TR-90-0097) Avail: NTIS HC A03/MF A01 CSCL 12/5

The Strategic High-Altitude Radiance Code (SHARC) is a new computer code that calculates atmospheric radiation in the mesosphere and thermosphere. The initial version, SHARC-1, is available for distribution. This talk discusses the capabilities of this code and describes the new auroral model which will be incorporated in the next version. SHARC calculates radiance and transmittance for paths from 60 to 300 km altitude in the 2 to 40 microns spectral region. It models radiation due to NLTE (Non-Local Thermodynamic Equilibrium) molecular emissions which are the dominant sources at these altitudes. GRA

N90-24699# Georgia State Univ., Atlanta. Center for High Angular Resolution Astronomy.
SUPER-DIFFRACTION LIMITED MEASUREMENTS THROUGH THE TURBULENT ATMOSPHERE BY SPECKLE INTERFEROMETRY Final Technical Report, 15 May 1986 - 14 Nov. 1989
Harold A. McAlister 22 Feb. 1990 219 p
(Grant AF-AFOSR-0134-86; AF Proj. 2311)
(AD-A221227; AFOSR-90-0492TR) Avail: NTIS HC A10/MF A02 CSCL 03/1

Speckle interferometric methods provide a means for reconstructing diffraction limited images from atmospherically blurred image data obtained in snapshots with exposure times shorter than the atmospheric redistribution time, typically shorter than 20 milliseconds. Several areas of research were emphasized: (1) Speckle Photometry - The extraction of the differential brightness and color of the components of close binary stars has always been a fundamental limit to the usefulness of these objects to stellar astrophysics. Simple and fast methods were developed and applied to actual data which enable the measurement of these parameters for large numbers of stars. Newly developed algorithms include a directed vector-autocorrelation (DVA) technique for eliminating the 180 deg quadrant ambiguity inherent in speckle interferometric measurements of the astrometry of binary stars. DVA is a simple extension of normal vector-autocorrelation and requires orders of magnitude less computing time that standard image reconstruction methods when applied to binary stars. The second new algorithm is known as the fork method and provides a means for a statistically based determination of the intensity ratio of a binary at any selected wavelength, thereby providing color information through the comparison of any two wavelengths. (2) Super Diffraction-Limited Detection - The very high accuracy of speckle astrometry provides a leveraging method for detecting close companions whose spatial separations are far less than the diffraction limit. GRA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N90-24700# Florida State Univ., Tallahassee. Geophysical Fluid Dynamics Inst.
[THE ROLE OF EDDY FLUXES OF MOMENTUM IN HURRICANE FORMATION] Final Report
Richard L. Pfeffer 1989 16 p
(Contract N00014-77-C-0265)
(AD-A219417) Avail: NTIS HC A03/MF A01 CSCL 04/2

In a series of 5 papers, the hypothesis was confirmed that large scale eddy fluxes of momentum associated with upper level asymmetries in the wind field play a fundamental role in hurricane formation. They do this by inducing the radial circulation which draws warm, moist lower tropospheric air inward toward the center of the disturbance over a large fetch of ocean and pumps drier air out at higher elevations. In the studies by Challa and Pfeffer and Pfeffer and Challa, Sundqvist's symmetric hurricane model was used and modified to include parameterized eddy fluxes of momentum, to investigate the role of such fluxes in hurricane formation. The accomplishments in three major areas are described: (1) The mechanism of hurricane formation; (2) Diagnostic studies of wave-mean flow interactions in the atmosphere; and (3) Laboratory simulations of fundamental atmospheric processes. GRA

N90-24701# Naval Research Lab., Washington, DC.
A CORRELATION STUDY OF WIND SPEED AS MEASURED BY THE SPECIAL SENSOR MICROWAVE/IMAGER AND THE GEOSAT ALTIMETER M.S. Thesis
James E. Lilly Sep. 1989 79 p
(AD-A219841) Avail: NTIS HC A05/MF A01 CSCL 04/2

Wind speed data is routinely acquired at the Fleet Numerical Oceanographic Center (FNOC) in near real time from the Special Sensor Microwave/Imager (SSM/I), on board the Defense Meteorological Satellite Program (DMSP) satellite and the radar altimeter on board the GEOSAT satellite. A correlation study is made of the SSM/I and altimeter wind speed data using five data sets from areas where the DMSP satellite had crossed within 1.1 hours of the GEOSAT satellite. Regions of ocean where the atmosphere was free of cloud water and precipitation have a high correlation of approximately 0.995, while areas with precipitation and cloud water have very poor correlation. Areas of high water vapor content do not appear to adversely affect the high correlation between the SSM/I and altimeter measured wind speeds. GRA

N90-24702# Scripps Institution of Oceanography, La Jolla, CA. Marine Physical Lab.
EVALUATION OF STOCHASTIC MODELS FOR ESTIMATING THE PERSISTENCE PROBABILITY OF CLOUD-FREE LINES-OF-SIGHT Scientific Report No. 1, 1 Oct. 1988 - 30 Sep. 1989
Wayne S. Hering 30 Sep. 1989 21 p
(Contract F19628-88-K-0005; AF Proj. 6670)
(AD-A220283; SIO-REF-89-25; GL-TR-89-0275) Avail: NTIS HC A03/MF A01 CSCL 04/2

Stochastic models, based upon the Ornstein-Uhlenbeck (O-U) class of the simple Markov process have been used effectively to estimate the conditional probability of a variety of weather events (Gringorten, 1972). This study is directed toward extension of the analytical form of the O-U Markov model to yield estimates of the joint occurrence probability and duration of sky cover and cloud free lines of sight (CFLOS). As a first step, model estimates are made of the recurrence probability of CFLOS for specific categories of sky cover in tenths as a function of time. Then model calculations are made for the persistence probability of CFLOS and sky cover as a function of sky-cover category and time using an analytical representation of the mathematic solution of persistence probability for the O-U Markov process given by Kielson and Ross (1975). The model calculations of CLFOS recurrence and persistence are compared with the Columbia, MO, data base (Lund, 1973). Again using an analytical form of the O-U Markov model, calculations are made of the joint occurrence probability of sky-cover at two or more sites and compared with the observations from the central United States. Finally, analytic techniques are presented for calculating probability estimates of the duration of cloud-free or cloudy lines of sight from one or multiple ground sites to points in space. Trial calculations based upon climatic summaries of sky-cover are made for a selected group of sites in south western United States. GRA

N90-24703# Atmospheric and Environmental Research, Inc., Cambridge, MA.
IMPACT OF A UNIFIED DMSP METEOROLOGICAL SENSOR RETRIEVAL METHODOLOGY ON GLOBAL NUMERICAL WEATHER PREDICTION Final Report, Nov. 1988 - Nov. 1989
R. G. Isaacs, C. Grassotti, R. N. Hoffman, T. Nehrkorn, J.-F. Louis, and M. Mickelson 27 Feb. 1990 76 p
(Contract F19628-89-C-0011)
(AD-A220306; GL-TR-89-0334) Avail: NTIS HC A05/MF A01 CSCL 04/2

An observing system simulation experiment (OSSE) is conducted using simulated DMSP microwave sensor data, surrogate data for cloud imagery (all based on a natural run), and the application of the unified retrieval (UR) method for DMSP to obtain meteorological variables as proposed by Isaacs (23). Both the DMSP SSM/T-1 temperature sounder and SSM/T-2 moisture sounder data are simulated. The unified retrieval uses physical considerations based on a forecast or other first guess by comparing the sensor data with those simulated using the first guess profiles. Although the preliminary UR did not perform better than the statistical retrieval, enhanced UR are found to be more accurate in terms of integrated water vapor amounts. The retrieved variables, primarily temperature and moisture, are used to construct initial conditions for input to the AFGL global spectral numerical weather prediction model. The resulting analyses and forecasts based on the present statistical retrieval scheme. The impact of

the preliminary UR used in this experiment was small. However, the enhanced UR should provide improved humidity analyses. GRA

N90-24704 Deutscher Wetterdienst, Offenbach am Main (Germany, F.R.).
REPORTS FROM THE GERMAN METEOROLOGICAL SERVICE. NO. 178: CLIMATOLOGICAL RESEARCH ABOUT THE ATMOSPHERIC COUNTER RADIATION AND COMPARISON OF CALCULATION PROCESSES BY MEANS OF MEASUREMENTS IN THE UPPER RHINE VALLEY (FED. REPUBLIC OF GERMANY) DURING A YEAR [BERICHTE DES DEUTSCHEN WETTERDIENSTES NO. 178: KLIMATOLOGISCHE UNTERSUCHUNG UEBER DIE ATMOSPHAERISCHE GEGENSTRAHLUNG UND VERGLEICH VON BERECHNUNGSVERFAHREN ANHAND LANGJAEHRIGER MESSUNGEN IM OBERRHEINTAL]
Ingo Keding (Freiburg Univ., Germany, F.R.) 1989 70 p In GERMAN; ENGLISH summary
(ISBN-3-88148-249-0; ISSN-0072-4130; ETN-90-96477)
Copyright Avail: Deutscher Wetterdienst, Frankfurter Strasse 135, D-6050 Offenbach am Main, Fed. Republic of Germany

The atmospheric infrared radiation is measured continuously from a climatological point of view. A weather-type classification was developed to determine the relationship of diurnal and annual variation according to weather conditions. This classification is applicable to other fields of climatology, such as periods of sunshine or cloud cover, as some examples of climatic diagrams, and microclimatic profiles of wind, temperature and humidity above a pine forest demonstrate. To estimate the calculation errors due to the number of input parameters, a comparison of several semi-physical computation methods with different complexities was carried out. The calculation of the radiation from overcast sky can be done accurately. The highest errors appear in weather-types with brocken clouds. ESA

N90-24705# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Wolkenphysik.
DERIVATION OF WIND FIELDS FROM DOPPLER MEASUREMENTS OF A SINGLE RADAR AND APPLICATION TO A COLD FRONT WITH NARROW RAINBAND Ph.D. Thesis - Ludwig-Maximilians-Univ.
Martin Hagen Nov. 1989 112 p In GERMAN; ENGLISH summary Original contains color illustrations
(DLR-FB-89-61; ISSN-0171-1342; ETN-90-96486) Avail: NTIS HC A06/MF A01; DLR, VB-PL-D O, Postfach 40 60 58, 5000 Cologne, Fed. Republic of Germany, 55.50 DM

A method was developed for the derivation of the horizontal wind vector from Doppler data of a single weather radar. For a horizontal resolution of about 5 km, the accuracy of the method is about 2 to 5 m/s. The method is applicable for studies of mesoscale phenomena within stratiform precipitation. A cold front with a narrow rainband was studied with this method and additional measurements systems. The wavelike structure of the rainband is caused by wind shear and stratification within the frontal zone. The cold front passes the Alpine foreland undisturbed and is retarded by the main ridge of the Alps for several hours. When reaching the Alps, the prefrontal wind field is modified significantly. The flow speed is reduced with simultaneous increase in the cross-flow circulation. ESA

N90-24706# Dugway Proving Ground, UT. Meteorology Div.
METHODOLOGY INVESTIGATION CALIBRATION AND QUALITY CONTROL FOR NEW METEOROLOGICAL INSTRUMENTATION, PART 1 Final Report, Oct. 1988 - Sep. 1989
Christopher A. Biltoft 15 Nov. 1989 88 p Sponsored by Army Test and Evaluation Command, Aberdeen Proving Ground, MD
(AD-A221407; DPG-FR-90-705-Pt-1) Avail: NTIS HC A05/MF A01 CSCL 04/2

U.S. Army Dugway Proving Ground (DPG) conducted tests to verify performance and develop quality control procedures for new meteorological instrumentation. The instrumentation tested included cup and sonic anemometers, Doppler acoustic sounders (sodars), and a crosswind scintillometer. Sonic anemometer intercomparison tests conducted at the Boulder Atmospheric Observatory (BAO) identified deficiencies in the DPG sonic anemometer software. These deficiencies are being corrected by the manufacturer. The sonic anemometer transducer shadow correction algorithm was characterized in a low turbulence wind tunnel. It's response in turbulent flow was then compared to the response of cup anemometers. These tests verified the sonic anemometer's transducer shadow correction algorithm. A novel means of evaluating cup anemometer overspeeding was developed from cup versus sonic anemometer intercomparisons. GRA

N90-24707# International Meteorological Inst., Stockholm (Sweden). Arrhenius Lab.
[ACTIVITIES REPORT IN METEOROLOGICAL RESEARCH AND ASSOCIATED FIELDS] Annual Report, Jul. 1988 - Jun. 1989
Dec. 1989 52 p
(ISSN-0349-0068; ETN-90-96952) Avail: NTIS HC A04/MF A01

The activities of the International Meteorological Institute (IMI) are described. Research activities in the areas of dynamic meteorology, chemical meteorology and biogeochemistry are reported. Research in atmospheric physics and atmospheric aerosol science is described. Lists of visiting scientists and their contributions to the activities of the IMI during the Jul. 1988 - Jun. 1989 period are described. The seminars given at the institute are listed. A list of publications and reports published by the institute is presented. ESA

N90-25040*# State Univ. of New York, Brockport. Dept. of Earth Sciences.
A QUANTITATIVE TECHNIQUE TO ESTIMATE MICROBURST WIND SHEAR HAZARD TO AIRCRAFT
Gregory P. Byrd *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 56-59 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 04B

N90-25066*# South Dakota School of Mines and Technology, Rapid City. Dept. of Mathematics and Computer Science.
CLOUD FIELD CLASSIFICATION BASED ON TEXTURAL FEATURES
Sailes Kumar Sengupta *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 141-145 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20D

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N90-24708# Naval Ocean Research and Development Activity, Bay Saint Louis, MS. Ocean Acoustics Div.
ENVIRONMENTAL MEASUREMENTS AND ANALYSIS: ARCTIC ACOUSTICS EXPERIMENTS IN THE MARGINAL ICE ZONE
Roger W. Meredith, Paul J. Bucca, and Kim McCoy (Ocean Sensors, Inc., Encinitas, CA.) Aug. 1989 75 p Sponsored by Office of Naval Technology
(AD-A220509) Avail: NTIS HC A04/MF A01 CSCL 08/3

From 27 April through 28 May 1988, personnel from NORDA and other institutions used the USCGC Northwind to establish an ice camp to conduct an environmental acoustics exercise in the Marginal Ice Zone (MIZ) between Greenland and Svalbard in the Fram Strait. This report documents the comprehensive set of

environmental data collected in support of the acoustic measurements. These data include expendable bathythermographs, conductivity-temperature-depth profiles, both vertical and time series current meter casts, meteorological and navigational measurements, and satellite imagery. This report also provides a brief synopsis of the sequence of events that transpired during the exercise, a preliminary environmental analysis, and some suggestions for future MIZ experiments. GRA

N90-24709# Naval Postgraduate School, Monterey, CA.
A RANGE-DEPENDENT ANALYSIS OF ACOUSTIC TRANSMISSION ACROSS A COLD FILAMENT IN THE CALIFORNIA CURRENT M.S. Thesis
Lawrence M. Jendro Sep. 1989 73 p
(AD-A220175) Avail: NTIS HC A04/MF A01 CSCL 17/1

Conductivity, temperature and depth data were taken in a area where satellite imagery had detected a cold water filament to frequently recur in the California Current System in order to determine the temporal and spatial variability of the hydrographic and velocity fields. Sound speed profiles were constructed from this data and predicted sonar ranges (PSRs) were computed for passive sonar using a range-dependent parabolic equation model. Analysis of model results applied to tactical scenarios showed the acoustic advantage between two adversaries to change as their positions relative to the front and to each other were changed. An investigation of the acoustic mechanisms involved in the variation of PSRs showed that small variations in surface temperature were enough to cause significant changes in PSRs. Changes in temperature of sufficient magnitude to effects PSRs were found also in SST imagery of cold filaments in other eastern boundary currents around the world. GRA

51 LIFE SCIENCES (GENERAL)

N90-24710# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Abt. Biophysik.
IN VITRO PHOTOREACTIVATION OF TRANSFORMING DNA OF BACILLUS SUBTILIS SPORES AFTER IRRADIATION WITH UV LIGHT Ph.D. Thesis - Bonn Univ.
Corinna Panitz Aug. 1989 103 p In GERMAN; ENGLISH summary
(DLR-FB-89-45; ISSN-0171-1342; ETN-90-96454) Avail: NTIS HC A06/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 37.50 DM

The influence of UV radiation on the transforming system of bacillus subtilis spores and, for comparison, of vegetative cells was investigated. The UV sensitivity of transformation depends on the state of the DNA. Transformation is less UV-sensitive if DNA is UV-irradiated inside the bacterial spore as compared to in vitro UV irradiation. Photoreactivation only occurs after in vitro UV irradiation. Future study is planned to discover to what extent the enhanced UV sensitivity of bacillus subtilis spores, UV-irradiated in vaccum, is due the UV-induced cis-syn thymine dimer. ESA

N90-24711# Massachusetts Inst. of Tech., Cambridge. Dept. of Brain and Cognitive Sciences.
STRATEGIES TO SUSTAIN AND ENHANCE PERFORMANCE IN STRESSFUL ENVIRONMENTS Final Report, 30 Sep. 1987 - 14 Dec. 1989
Harris R. Lieberman, Andrew B. Dollins, and Richard J. Wurtman 14 Mar. 1990 24 p
(Grant AF-AFOSR-0402-87; AF Proj. 2312)
(AD-A221224; AFOSR-90-0403TR) Avail: NTIS HC A03/MF A01 CSCL 06/15

Tyrosine, a large neutral amino acid normally present in protein foods, is the precursor of the catecholamine neurotransmitters dopamine, norepinephrine, and epinephrine. Animal studies indicate that systemic administration of tyrosine in pharmacologic quantities can reduce physiological and behavioral decrements induced by highly stressful conditions. The current study was designed to test the effects of tyrosine on humans exposed to cardiovascular stress. Physiological (HR, BP, AER, EOG, and EMG) and Behavioral (Rt, Mood, and Vigilance) indices were monitored during testing. Comparisons indicate that the effects of tyrosine ingestion include: (1) overall increase in pulse pressure (LBNP typically reduces pulse pressure); (2) an increase in P300 amplitude (indicating increased cognitive activity) when participating in the odd-ball task; and (3) a non-significant increase (22 percent) in LBNP tolerance among subjects who could not withstand LBNP for the full 30 minute period. Results of this study indicate that elevated blood plasma tyrosine levels reduce physiological decrements caused by LBNP stress. GRA

N90-24712# Illinois Univ., Urbana. Lab. of Immunophysiology.
RECIPROCAL RELATIONSHIPS BETWEEN THE IMMUNE AND CENTRAL NERVOUS SYSTEM Annual Report
Keith W. Kelley and Robert Dantzer 1 May 1990 8 p
(Contract N00014-89-J-1956)
(AD-A221259) Avail: NTIS HC A02/MF A01 CSCL 06/1

How the neuroendocrine system affects macrophage activation and how products derived from activated macrophages affect animal behavior is investigated. It was shown that interferon-lambda effectively counteracts the suppression in the synthesis of macrophage-derived tumor necrosis factors-alpha caused by both glucocorticoids and transforming growth factor beta-2. Furthermore, the decline in synthesis of TNF-a and secretion of superoxide anion that occurs in macrophages from aged rats can be significantly reversed by syngeneic pituitary grafts. Macrophage productas are also responsible for some aspects of sickness behavior, as defined by peripheral and central injections of interleukin-1 inducing conditioned taste aversion in both endotoxin sensitive and resistant mice. Indomethacin and aspirin do not block the effects of IL-1 on conditioned taste aversion, but they both inhibit the reductions in social exploration and schedule-controlled behavior of rats injected peripherally with IL-1. These data support the idea that macrophage products are responsible for behavioral symptoms of illness following a bacterial infection, and that macrophage activation is regulated by hormones from the pituitary gland. GRA

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N90-24713# Universal Energy Systems, Inc., Dayton, OH.
AN INVESTIGATION INTO TECHNIQUES FOR LANDMARK IDENTIFICATION OF 3D IMAGES OF HUMAN SUBJECTS, PHASE 1
Randy Beth Pollock (Wright State Univ., Dayton, OH.) Aug. 1989 18 p
(Contract F49620-88-C-0053; AF Proj. 7184)
(AD-A218614; AAMRL-SR-90-500) Avail: NTIS HC A03/MF A01 CSCL 23/2

Anthropometric data have been used by the Air Force for many years to help in the design of clothing, equipment, cockpits, etc. The use of anthropometric statistics enables designers to provide a better-fitting product and ensure that the people who will be using the equipment are physically able to do so. The Human Engineering Division has been exploring the use of 3-dimensional scanning technology to produce a digital representation of the surface of the human head. A vertical stripe of laser light is projected onto a stationary subject as the scanner rotates 360 degrees around him or her, taking video recordings which are converted into digital format. Although the data collected in this way are much more complete than was possible using traditional methods, techniques have not yet been developed to easily analyze and use this type of data. Several approaches to landmark identification using artificial intelligence methodologies were investigated. A blackboard architecture was identified as the most promising approach. Several prototype modules were developed to generate and evaluate hypotheses regarding the

positions of the landmarks on 3-D digital images. These were tested on a sample of 20 subjects and the results were sufficiently encouraging to warrant further work. The design of a blackboard system was begun, including components utilizing other technologies such as neural networks and constraint networks. GRA

N90-24714# California Univ., Irvine.
ANALYSIS OF NEURAL SYSTEMS INVOLVED IN MODULATION OF MEMORY STORAGE Final Technical Report, 1 Jun. 1987 - 31 May 1990
James L. McGaugh 1990 6 p
(Contract N00014-87-K-0518)
(AD-A220230) Avail: NTIS HC A02/MF A01 CSCL 06/4

The research supported by this contract over the past three years examined the role of neuromodulatory systems in the modulation of memory storage processes. The research was based on extensive evidence from previous studies indicated that memory storage processes are modulated by neuromodulatory systems activated by learning experiences. It is well documented that, in laboratory animals, retention is modified by posttraining administration of stress-related hormones as well as neurotransmitters and drugs that influence hormonal and neurotransmitter systems. Research in the laboratory has examined the effects of treatments affecting adrenergic, cholinergic, opioid peptidergic and, most recently, GABAergic systems. Previous studies indicated that these neuromodulatory systems may influence memory through effects involving the amygdaloid complex. More generally, the findings of preliminary studies suggested that the amygdala may serve to integrate the effects of neuromodulatory systems on memory storage. The aim of the research supported by this contract was: (1) to increase our understanding of the locus of brain regions involved in the effects, on memory of treatments affecting neuromodulatory systems, and (2) to determine whether treatments affecting memory storage work through a common set of brain systems. GRA

N90-24715# School of Aerospace Medicine, Brooks AFB, TX.
DECOMPRESSION SICKNESS AFFECTING THE TEMPOROMANDIBULAR JOINT Final Report
Frederick W. Rudge 1990 7 p
(AD-A220959; USAFSAM-JA-90-6) Avail: NTIS HC A02/MF A01 CSCL 06/10

Three cases of pain-only decompression sickness of the temporomandibular joint following altitude chamber exposure are presented. A detailed interview of each individual revealed no other joint involvement or other complaints. A careful neurologic examination failed to disclose abnormalities. In each case, the pain resolved completely with recompression, supporting the diagnosis of decompression sickness. Decompression sickness limited to this small joint is extremely rare, and may easily be confused with other causes of joint pain. GRA

N90-24716# Naval Air Development Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.
RHEOENCEPHALOGRAPHY IN SIMULATED AVIATION ENVIRONMENTAL STRESS Interim Report - Ph.D. Thesis - Drexel Univ.
Barry Scott Shender 1 Jun. 1989 170 p
(AD-A221150; NADC-89042-60) Avail: NTIS HC A08/MF A01 CSCL 06/10

The use of electrical impedance plethysmography of the head, or Rheoencephalography (REG), has been demonstrated in a high acceleration stress environment on human volunteer subjects. Acceleration stress was applied in the head-to-foot direction and is referred to as +Gz. The REG instrument divides the cephalic impedance waveform into two components: (1) a baseline impedance signal, Zb, that is referable to the bulk movement of blood in and out of the head, and (2) a pulsatile impedance waveform that is heart beat coincident. The REG waveform also contains information about cerebrospinal fluid (CSF) volume changes and shifts resulting from the application of acceleration stress. Blood and CSF shifts in and out of the cranial and spinal compartments impinge directly upon the overall function of the central nervous system. The high acceleration environment provides an ideal arena in which to alter cephalic fluid volumes noninvasively in order to obtain basic physiologic knowledge of importance to both aviation and clinical medicine. GRA

N90-24717# Dayton Univ., OH.
EFFECTS OF PYRIDOSTIGMINE BROMIDE ON A-10 PILOTS DURING EXECUTION OF A SIMULATED MISSION: PHYSIOLOGY Interim Report, Jul. 1984 - May 1989
Arthur E. Harriman, David C. Hubbard, Rebecca B. Brooks, and Robert R. Woodruff (Air Force Human Resources Lab., Williams AFB, AZ.) Apr. 1990 40 p Prepared in cooperation with Air Force Human Resources Lab., Brooks AFB, TX
(AD-A221222; AFHRL-TR-89-24) Avail: NTIS HC A03/MF A01 CSCL 15/6

The physiological results are documented of an experiment that was conducted to determine the effects of pyridostigmine bromide (PB) (30 milligrams, three times per day) on pilot performance and physiology. Both sets of data were collected in an A-10 flight simulator with an Advanced Visual Technology System (AVTS). The subjects were 24 A-10 pilots who were trained on the following simulated tasks over three 55-minute sessions: takeoff, patterns, emergency procedure, and landing; air-to-air refueling; conventional low-angle strafing; and low-level ingress/RED FLAG. Next, during two test sessions, 48 hours apart, the pilots were tested using a double-blind procedure on the same tasks in a PB condition and in a placebo condition. In the two test sessions, 12 of the pilots wore the chemical defense ensemble (CDE) and the other 12 pilots wore standard flight gear (SFG). PB dosages led to reports of 27 symptoms among 12 (50 percent) of the pilots. Under the placebo condition, in contrast, only 5 (20 percent) of the pilots reported a total of 6 symptoms. Analyses of PB effects on physiological functions and on various biobehavioral measures showed suppression of heart rate and a tendency toward increased skin temperature. Besides increasing skin temperature, the CDE tended to increase heart rate, especially during the start of the session. GRA

N90-24718# National Inst. of Health, Bethesda, MD. National Center for Human Genome Research.
UNDERSTANDING OUR GENETIC INHERITANCE. THE US HUMAN GENOME PROJECT: THE FIRST FIVE YEARS, FY 1991-1995
Apr. 1990 89 p Prepared in cooperation with US DOE Office of Energy Research, Washington, DC
(DE90-008240; DOE/ER-0452P) Avail: NTIS HC A05/MF A01

The Human Genome Initiative is a worldwide research effort with the goal of analyzing the structure of human DNA and determining the location of the estimated 100,000 human genes. In parallel with this effort, the DNA of a set of model organisms will be studied to provide the comparative information necessary for understanding the functioning of the human genome. The information generated by the human genome project is expected to be the source book for biomedical science in the 21st century and will by of immense benefit to the field of medicine. It will help us to understand and eventually treat many of the more than 4000 genetic diseases that affect mankind, as well as the many multifactorial diseases in which genetic predisposition plays an important role. A centrally coordinated project focused on specific objectives is believed to be the most efficient and least expensive way of obtaining this information. The basic data produced will be collected in electronic databases that will make the information readily accessible on convenient form to all who need it. This report describes the plans for the U.S. human genome project and updates those originally prepared by the Office of Technology Assessment (OTA) and the National Research Council (NRC) in 1988. In the intervening two years, improvements in technology for almost every aspect of genomics research have taken place. As a result, more specific goals can now be set for the project. DOE

N90-24976*# Alabama Univ., Tuscaloosa.
NONINVASIVE ESTIMATION OF FLUID SHIFTS BETWEEN BODY COMPARTMENTS BY MEASUREMENT OF BIOELECTRIC CHARACTERISTICS Final Report
Phillip A. Bishop *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 15 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 06P

N90-24978*# Alma Coll., MI. Dept. of Exercise and Health Science.
EFFECT OF FLUID COUNTERMEASURES OF VARYING OSMOLARITY ON CARDIOVASCULAR RESPONSES TO ORTHOSTATIC STRESS Final Report
John E. Davis *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 14 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 06P

N90-24989*# Fordham Univ., New York, NY. Div. of Science and Mathematics.
THE EFFECTS OF SIMULATED HYPOGRAVITY ON MURINE BONE MARROW CELLS
DeSales Lawless *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 15 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 06P

N90-24993*# Texas Univ., Galveston. Dept. of Pharmacology and Toxicology.
CONSERVATION OF BODY CALCIUM BY INCREASED DIETARY INTAKE OF POTASSIUM: A POTENTIAL MEASURE TO REDUCE THE OSTEOPOROSIS PROCESS DURING PROLONGED EXPOSURE TO MICROGRAVITY Final Report
Bohdan R. Nechay *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 6 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 06P

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N90-24719# Army Research Inst. for the Behavioral and Social Sciences, Alexandria, VA.
THE INCREMENTAL VALIDITY OF SPATIAL AND PERCEPTUAL-PSYCHOMOTOR TESTS RELATIVE TO THE ARMED SERVICES VOCATIONAL APTITUDE BATTERY Final Report, Jul. - Nov. 1989
Henry H. Busciglio Feb. 1990 42 p
(AD-A220903; ARI-TR-883) Avail: NTIS HC A03/MF A01 CSCL 05/9

This research evaluates the utility of new Army tests of spatial, perceptual, and psychomotor abilities developed under the Army's Project A (Improving the Selection, Classification, and Utilization of Army Enlisted Personnel). Utility is judged in terms of incremental validity over the Armed Services Vocational Aptitude Battery (ASVAB). The analyses are stepwise regressions using predictors and performance tests from the 1985 Concurrent Validation of Project A. A variety of performance measures, ranging from comprehensive to task-level, served as criteria for the analyses. In the analyses, optimal combinations of Project A predictors substantially augmented the proportion of criterion variance explained by optimal combinations of ASVAB scores alone, particularly for such comprehensive measures as General Soldiering Proficiency and the combined score on written tests of school and job knowledge. In certain Military Occupational Specialties (MOS), Project A scores led to increments in the predictability of more specific criteria, such as Target Identification and Navigation. While no strong support was found for the relative superiority of spatial versus perception psychomotor scores, there was evidence that some individual tests (viz., Assembling Objects, Figural Reasoning, and Target Identification) were more useful than others as incremental predictors of the criteria. Because of the concurrent design used and the lack of opportunities for cross-validation, these generally favorable findings only suggest the results to be expected from the Longitudinal Validation of Project A. GRA

N90-24720# Embry-Riddle Aeronautical Univ., Daytona Beach, FL.
PILOT DECISION-MAKING TRAINING Final Technical Report, Jun. 1985 - Dec. 1988
Thomas J. Connolly May 1990 88 p Sponsored by Air Force Human Resources Lab., Williams AFB, AZ
(AD-A221349; AFHRL-TP-88-67) Avail: NTIS HC A05/MF A01 CSCL 01/3

The effectiveness of a simulator-based approach to training pilot skills in risk assessment and decision making was evaluated in a sample for pilots enrolled in a university aviation science program. Experimental group subjects received 4 hours of classroom instruction designed to enhance pilot judgement skills, followed by 4 hours of simulated cross-country flights during which several critical in-flight events occurred. Subjects in the control group received classroom instruction in basic instrument flying, followed by simulator sessions emphasizing instrument flight. Measures of pilot judgement were obtained on all subjects before and after the training, and subjects in the experimental judgement-trained group performed significantly better on the post-training simulation than did control group subjects. The findings suggest that significant gains in pilot decision-making skill can be obtained through the use of the judgement training materials along with simulator practice. The implications of these findings for Air Force undergraduate pilot training are discussed. Included as an appendix to this document is a prototype manual for pilot decision making. This manual is designed for use by Air Force student pilots as part of their regular training program. A specific plan for implementation is proposed. At a later date, similar advanced training materials may be developed for both simulator and in-flight use. GRA

N90-24721# National Aerospace Medical Centre, Soesterberg (Netherlands).
[ACTIVITIES REPORT OF THE NATIONAL AEROSPACE MEDICAL CENTER] Annual Report, 1988 [STICHTING NATIONAL LUCHT- EN RUIMTEVAARTGENEESKUNDIG CENTRUM, JAARVERSLAG 1988]
1988 39 p In DUTCH
(ETN-90-96936) Avail: NTIS HC A03/MF A01

The personnel selection examinations performed in 1988 are tabulated, and the evolution of the examinations since 1952 is given. The psychological test apparatus was extended and modernized in order to meet the strongly increased demand for psychological aptitude tests. The mental stress of civilian helicopter pilots was investigated. The study of the visual behavior of presbyopic pilots and the use of optical aids was continued. Vestibular effects of gravitational loading were examined using a human centrifuge. ESA

N90-24982*# North Carolina Univ., Chapel Hill. Dept. of Physical Education, Exercise and Sport Sciences.
OVERTRAINING AND EXERCISE MOTIVATION: A RESEARCH PROSPECTUS Final Report
Anthony C. Hackney *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 16 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 05I

N90-25041*# Stonehill Coll., North Easton, MA. Dept. of Mathematics and Computer Science.
FROM WHERE THEY LOOK TO WHAT THEY THINK: DETERMINING CONTROLLER COGNITIVE STRATEGIES FROM OCULOMETER SCANNING DATA

Steven Cushing *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 60-66 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 05I

N90-25059*# Hampton Univ., VA. Dept. of Management.
A SYSTEMATIC APPROACH TO TRAINING: A TRAINING NEEDS ASSESSMENT
Margaret H. Manning *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 114-116 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 05I

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N90-24722# Dartmouth Coll., Hanover, NH. Dept. of Psychiatry.
DURIP: IMPROVED EYE MOVEMENT MONITORING CAPABILITIES FOR STUDIES IN VISUAL COGNITION Final Report, 1 Dec. 1988 - 31 Nov. 1989
Robert Fendrich 27 Feb. 1990 7 p
(Grant AF-AFOSR-0191-89; AF Proj. 3842)
(AD-A220355; AFOSR-90-0362TR) Avail: NTIS HC A02/MF A01 CSCL 06/4

We have interfaced the new Image eyetracker with a Hewlett-Packard 1310 large screen display and IBM PC/AT computer. The IBM contains a Data-Translation high speed D/A-A/D board and a vector drawing board. Specialized software has been developed to analyze the characteristics of both pursuit and saccadic eye motions. The investigations described below are representative subset of the studies we are conducting with the eyetracker. GRA

N90-24723# Pennsylvania Univ., Philadelphia. Dept. of Computer and information Science.
REAL TIME INVERSE KINEMATICS WITH JOINT LIMITS AND SPATIAL CONSTRAINTS Interim Report
Jianmin Zhao and Norman I. Badler 9 Jan. 1989 23 p
(Contracts DAAL03-89-C-0031; DAAG29-84-9-0027; DAAG29-84-K-0061; NSF MCS-82-19196; NSF IST-86-12984; NSF DMC-85-16114; NSF IRI-84-10413)
(AD-A220462; MS-CIS-89-09; Graphics-Lab-27; ARO-26779.9-EL-AI) Avail: NTIS HC A03/MF A01 CSCL 05/8

A configuration of an articulated figure of joints and segments can sometimes be specified as spatial constraints. Constrained parts on the articulated figure are abstracted as end effectors, and the counterparts in the space are abstracted as goals. The goal (constraint) can be as simple as a position, an orientation, a weighted combination of position and orientation, a line, a plane, a direction, and so on, or it could be as complicated as a region in the space. An articulated figure consists of various segments connected together by joints. Each joint has some degrees of freedom which are subject to joint limits and manual adjustment. An efficient algorithm is presented to adjust the joint angles subject to joint limits so that the set of end effectors concurrently attempt to achieve their respective goals. Users specify end effectors and goals: the program computes a final configuration in real time in the sense that actions appear to take no longer than actual physical activities would. If it is impossible to satisfy all the goals owing to the actual constraints, the program should end up with the best possibility according to the user's assignment of importances to each goal. Author

N90-24724# Anacapa Sciences, Inc., Fort Rucker, AL.
A SURVEY OF HUMAN FACTORS METHODOLOGIES AND MODELS FOR IMPROVING THE MAINTAINABILITY DESIGN OF EMERGING ARMY AVIATION SYSTEMS Interim Report, Dec. 1987 - Feb. 1989
John W. Ruffner Feb. 1990 73 p
(Contract MDA903-87-C-0523; DA Proj. 2Q2-63007-A-793)
(AD-A221159; ASI690-321-89; ARI-TR-878) Avail: NTIS HC A04/MF A01 CSCL 23/2

This report presents the findings of a literature review conducted to identify human factors methods and models that might be used to improve the maintainability of emerging Army aviation systems. Three methods and seven models are reviewed. The three methods are Logistic Support Analysis, Hardware versus Manpower, and Acquisition of Supportable Systems Evaluation Technology. The seven models are the Human Operator Simulator, Microcomputer Systems Analysis of Integrated Networks of Tasks, Sequiturs Workload Analysis System, Task Analysis and Workload, Maintenance Personnel Simulation, Crew Chief, and Profile. A comparison of the methods and models suggests that the Crew Chief and Profile models have the greatest immediate use for improving maintainability design. It is recommended that research be initiated that will evaluate the Crew Chief and Profile models to see if they can be applied to the maintainability design of Army aviation systems; investigate ways in which the other models might be modified and applied to Army aviation maintainer tasks; and begin a program of maintainability research to address Army aviation systems, mission requirements, and operational environments. GRA

N90-24725# Letterman Army Inst. of Research, San Francisco, CA. Div. of Ocular Hazards.
FIELD EVALUATION OF LASER PROTECTIVE EYEWEAR Report, Jun. - Aug. 1989
George R. Mastroianni, Jeffrey D. Gunzenhauser, David A. Stamper, Kathryn H. M. Knudson, and Bruce E. Stuck Oct. 1989 57 p
(AD-A221324; LAIR-445) Avail: NTIS HC A04/MF A01 CSCL 05/8

A group of seventy soldiers at the National Training Center were issued Ballistic and Laser Protective Spectacles (B-LPS). The soldiers were surveyed after 90 days of B-LPS use, and again after 180 days. A pencil and paper inventory addressing durability, compatibility, and acceptability was administered at both 90 and 180 days; in addition, a photographic analysis of fit was performed at the 90 day point. Results indicated good overall acceptability and excellent durability. Problem areas were identified as susceptibility to abrasion from dust, lack of protection against blowing dust, and incompatibility with the PASGT (Kevlar) and Combat Vehicle Crewman (CVC) helmets. Recommendations for design changes are suggested. GRA

N90-24296# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
THE EUROPEAN EVA SUIT: AN OPTIMIZED TOOL FOR HERMES/MTFF IN-ORBIT OPERATIONS
L. Siomionesco, J. R. Chevallier, A. I. Skoog, and N. Herber (Dornier System G.m.b.H., Friedrichshafen, Germany, F.R.) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 93-98 (For primary document see N90-24280 18-12)
Copyright Avail: NTIS HC A19/MF A03; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders

N90-24297# Aeritalia S.p.A., Turin (Italy). Space Systems Group.
PERSPECTIVE FEATURES OF INTERNAL AUTOMATION AND ROBOTICS FOR SUPPORTING COLUMBUS ATTACHED LABORATORY PAYLOAD OPERATIONS
Mario Cardano, Maria Stella Lavitola, Ignazio Barraco, and Marc Toussaint (European Space Agency, Paris, France) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 99-112 (For primary document see N90-24280

18-12)
Copyright Avail: NTIS HC A19/MF A03; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders

N90-24298# McDonnell-Douglas Space Systems Co., Huntington Beach, CA. Space Station Div.
TELEROBOTIC APPLICATION TO EVA
Davis E. Anderson *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 115-121 (For primary document see N90-24280 18-12)
Copyright Avail: NTIS HC A19/MF A03; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders

N90-24299# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
HERA AND EVA CO-OPERATION SCENARIOS
F. Didot and W. Luettgen *In its* Second European In-Orbit Operations Technology Symposium Dec. 1989 p 123-128 (For primary document see N90-24280 18-12)
Copyright Avail: NTIS HC A19/MF A03; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders

N90-24300# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
ROBOT-BASED EQUIPMENT MANIPULATION AND TRANSPORTATION FOR THE COLUMBUS FREE FLYING LABORATORY
W. DePeuter, P. Putz, and G. Colombina (Tecnospazio S.p.A., Milan, Italy) *In its* Second European In-Orbit Operations Technology Symposium Dec. 1989 p 129-134 (For primary document see N90-24280 18-12)
Copyright Avail: NTIS HC A19/MF A03; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders

N90-24301# MATRA Espace, Paris-Velizy (France).
THE HERMES ROBOT ARM TELEOPERATION AND CONTROL CONCEPT
G. Andre and P. Schoonejans (Fokker B.V., Amsterdam, Netherlands) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 137-149 Sponsored in part by Fokker B.V., Amsterdam, Netherlands and ESA (For primary document see N90-24280 18-12)
Copyright Avail: NTIS HC A19/MF A03; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders

N90-24302*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TELEROBOTIC ARCHITECTURE FOR AN ON-ORBIT SERVICER
Neville I. Marzwell *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 151-157 (For primary document see N90-24280 18-12)
Copyright Avail: NTIS HC A19/MF A03; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders CSCL 05H

N90-24303# Centre National d'Etudes Spatiales, Toulouse (France).
HERA TELEOPERATION TEST FACILITY
V. Bourdon-Henry *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 161-165 (For primary document see N90-24280 18-12)
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N90-24304# British Aerospace Dynamics Group, Bristol (England). Dept. of Human Factors.
A FLEXIBLE TELEOPERATION TEST BED FOR HUMAN FACTORS EXPERIMENTATION
J. L. Evans and I. G. D. Strachan (United Kingdom Atomic Energy Authority, Culham, England) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 167-171 (For primary document see N90-24280 18-12)
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N90-24305# Tohoku Univ., Sendai (Japan). Dept. of Precision Engineering.
TELEOPERATION OF A FORCE CONTROLLED ROBOT MANIPULATOR WITHOUT FORCE FEEDBACK TO A HUMAN OPERATOR
Masaru Uchiyama and Kosei Kitagaki *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 173-179 Sponsored in part by Ministry of Education, Science and Culture, Japan (For primary document see N90-24280 18-12)
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N90-24307# MATRA Espace, Paris-Velizy (France).
THE BI-ARM SERVICER: A MULTIMISSION CONCEPT AND A TECHNOLOGICAL MODEL FOR SPACE ROBOTICS
G. Andre, G. Berger, and A. Elfving (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 191-204 (For primary document see N90-24280 18-12)
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N90-24333# Tecnomare S.p.A. (Italy).
SUPERVISORY CONTROLLED TELEMANIPULATION AND VISION SYSTEMS FOR INSPECTION AND MAINTENANCE OPERATIONS
Walter Prendin, Danilo Maddalena, Antonio Terribile, and Giovanni Sylos Labini (Italian Space Agency, Rome.) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 429-435 Sponsored by Commission of the European Communities; Istituto Mobiliare Italiano; AGIP; ANSALDO; European Nuclear Energy Agency; SAIPEM; and Tecnomare S.p.A. (For primary document see N90-24280 18-12)
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N90-24481# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Life Support and Habitability Section.
THE EUROPEAN EVA SPACESUIT MECHANISMS
Guido Albertini *In its* Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 129-133 (For primary document see N90-24462 18-31)
(Contract ESTEC-7790/88/NL/PB(SC))
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N90-24975*# Armstrong State Coll., Savannah, GA. Dept. of Biology.
EFFECT OF LOW AIR VELOCITIES ON THERMAL HOMEOSTASIS AND COMFORT DURING EXERCISE AT SPACE STATION OPERATIONAL TEMPERATURE AND HUMIDITY Final Report
Ronald J. Beumer *In* Texas A&M Univ., NASA/ASEE Summer Faculty Felloship Program-1989, Volume 1 Dec. 1989 15 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 05H

N90-24977*# Houston Univ., Clear Lake, TX. School of Natural and Applied Sciences.
IDENTIFYING ATMOSPHERIC MONITORING NEEDS FOR SPACE STATION FREEDOM Final Report
Dennis M. Casserly *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 15 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 06K

N90-24981*# Montana State Univ., Bozeman. Dept. of Chemistry.
ELECTROCHEMICAL CONTROL OF IODINE DISINFECTANT FOR SPACE TRANSPORTATION SYSTEM AND SPACE STATION POTABLE WATER Final Report
Richard D. Geer *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 15 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 06K

N90-24983*# Texas Univ., Galveston. Dept. of Physical Therapy.
RESEARCH IN HUMAN PERFORMANCE RELATED TO SPACE: A COMPILATION OF THREE PROJECTS/PROPOSALS Final Report
Scott M. Hasson *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 13 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 05H

N90-24987*# Houston Univ., TX. Dept. of Psychology.
KNOWLEDGE-BASED CONTROL OF AN ADAPTIVE INTERFACE Final Report
Roy Lachman *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 12 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 05H

N90-24995*# Texas Lutheran Coll., Seguin. Dept. of Biology.
THE USE OF UNDERWATER DYNAMOMETRY TO EVALUATE TWO SPACE SUITS Final Report
W. G. Squires *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 6 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 06K

N90-24999*# Texas A&M Univ., Galveston. Dept. of Marine Engineering.
A PRELIMINARY DESIGN OF INTERIOR STRUCTURE AND FOUNDATION OF AN INFLATABLE LUNAR HABITAT Final Report
Paul K. Yin *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 12 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 06K

N90-25058*# Montclair State Coll., Upper Montclair, NJ. Dept. of Psychology.
AN EMPIRICALLY DERIVED FIGURE OF MERIT FOR THE QUALITY OF OVERALL TASK PERFORMANCE
Moira LeMay *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 111-113 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 05H

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N90-24726# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
IMPLEMENTATION OF AN I-STRUCTURE MEMORY CONTROLLER
Kenneth M. Steele Mar. 1990 141 p
(Contract N00014-84-K-0099)
(AD-A221397; MIT/LCS/TR-471) Avail: NTIS HC A07/MF A01 CSCL 12/6

Memory systems in large-scale parallel processors are characterized by high bandwidth requirements, and long access latency. Because many processors are issuing concurrent memory requests, requests can arrive at the memory in any order. Dataflow processors present an elegant and clean solution for synchronizing parallel tasks and tolerating long memory latency by providing hardware synchronization for individual instructions, single word task-continuations, and split-phase memory transactions. These same ideas are applied to the development of a high-bandwidth memory system with hardware support for synchronization. Synchronization does not cause busy-waiting or retrying; synchronization delays appear to the processors simply as long latency memory accesses. I-structures are a method of memory access developed as an extension to the functional language Id to provide efficient data structures. Functional languages have the very important property of determinacy; program results are independent of the execution order of parallel tasks. By restricting each location to be write-once, data structures can remain determinate, regardless of the order of requests. The hardware stores, as lists, read request of unwritten locations. These deferred requests are serviced automatically when the value is written. Different methods for storing lists of deferred requests are investigated. GRA

N90-24727# Technische Univ., Berlin (Germany, F.R.). Fachbereich Elektrotechnik.
MICROCOMPUTER FOR THE DIGITAL REGULATION OF PERMANENT MAGNET-SYNCHRONOUS SERVOMOTORS Ph.D. Thesis [MIKRORECHNER FUER DIE VOLLSTAENDIG DIGITALE REGELUNG VON PERMANENTMAGNET-SYNCHRONSERVOMOTOREN]
Hans-Christian Reuss 1989 146 p In GERMAN
(ETN-90-96507) Avail: NTIS HC A07/MF A01

A control and regulation concept for a multi-axis system is presented in the case of highly dynamic servodrives. Some processes seemed to be particularly appropriate: optical incremental device for the measurement of location and the turn number, Hall-Sensors, VCO (Voltage Controlled Oscillator) and counters for the measurement of the machine currents and pulse width modulation and MOSFET (Metal Oxide Semiconductor Field Effect Transistor) for the output of values. A simplified mathematical model was shown to correctly describe the behavior of a three phase synchronous servomotor. For the used pulse frequency, the effects of the pulse modulation on momentum, turn number and location were found to be negligible. The hardware and the

algorithms used allowed analysis frequencies up to 1kHz to be obtained. ESA

N90-24728# Sandia National Labs., Albuquerque, NM.
SEU CHARACTERIZATION AND DESIGN DEPENDENCE OF THE SA3300 MICROPROCESSOR
F. W. Sexton, R. K. Treece, C. L. Axness, K. H. Hughes, G. L. Hash, and K. J. Hass 1990 4 p Presented at the 27th IEEE Annual International Nuclear and Space Radiation Effects Conference, Reno, NV, 16-20 Jul. 1990
(Contract DE-AC04-76DP-00789)
(DE90-007678; SAND-90-0480C; CONF-900723-9) Avail: NTIS HC A01/MF A01

The SA3300 16-bit microprocessor is a key component for interplanetary space probes to be launched in the 1990's. A full SEU characterization of the D-latches of the SA3300 is given, including pattern sensitivity and temperature. DOE

N90-24729# Fermi National Accelerator Lab., Batavia, IL.
RECENT EXPERIENCES AND FUTURE EXPECTATIONS IN DATA STORAGE TECHNOLOGY
Jack Pfister Apr. 1990 12 p Presented at the Computing in High Energy Physics, Santa Fe, NM, 9-13 Apr. 1990
(Contract DE-AC02-76CH-03000)
(DE90-011488; FNAL/C-90/70; CONF-9004190-5) Avail: NTIS HC A03/MF A01

For more than 10 years the conventional media for High Energy Physics has been 9 track magnetic tape in various densities. More recently, especially in Europe, the IBM 3480 technology has been adopted while in the United States, especially at Fermilab, 8mm is being used by the largest experiments as a primary recording media and where possible they are using 8mm for the production, analysis and distribution of data summary tapes. VHS and Digital Audio tape have recurrently appeared but seem to serve primarily as back-up storage media. The reasons for what appear to be a radical departure are many. Economics, form factor, and convenience are dominant among the reasons. The traditional data media suppliers seem to have been content to evolve the traditional media at their own pace with only modest enhancements primarily in value engineering of extant products. Meanwhile, start-up companies providing small system and workstations sought other media both to reduce the price of their offerings and respond to the real need of lower cost back-up for lower cost systems. This happening in a market context where traditional computer systems vendors were leaving the tape market altogether or shifting to 3480 technology which has certainly created a climate for reconsideration and change. The newest data storage products, in most cases, are not coming from the technologies developed by the computing industry but by the audio and video industry. Just where these flopticals, opticals, 19 mm tape and the new underlying technologies, such as, digital paper may fit in the HEP computing requirement picture will be reviewed. What these technologies do for and to HEP will be discussed along with some suggestions for a methodology for tracking and evaluating extant and emerging technologies. DOE

N90-24330# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
HIGH PERFORMANCE PROCESSING SYSTEM FOR EMBEDDED CONTROL APPLICATIONS IN SPACE
A. Elfving and A. T. Sund *In its* Second European In-Orbit Operations Technology Symposium Dec. 1989 p 393-401 (For primary document see N90-24280 18-12)
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61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N90-24730 New South Wales Univ., Kensington (Australia).
A STUDY OF EFFECTS OF INSTRUCTIONAL MODES IN A SEQUENCE OF COMPUTER-ASSISTED INSTRUCTION LESSONS, WITH AN INTRODUCTION TO COMPUTER-AIDED DIAGNOSIS OF ARITHMETIC ERRORS Abstract Only Ph.D. Thesis
Graham J. Barnsley Jan. 1989 3 p
Avail: Issuing Activity

The recent, rapid development of computer assisted instruction (CAI) methods in the teaching of mathematics has raised many questions for educators to consider. Some aspects of mathematics education, addressed in the past, now require a re-examination in the light of modern developments in the classroom use of computers. An investigation to assess the effects of CAI used in conjunction with concrete manipulative materials is described. The effects of interaction between these two factors have received little previous attention from researchers. A first study, using female, trainee primary school teachers as subjects, compared three treatment groups; symbolic, pictorial, and manipulative modes of presentation. The expected superiority of the manipulative mode was not apparent, with results suggesting that the pictorial mode might be the most effective. A second study compared only two treatments: symbolic and pictorial presentations, but used a larger sample, and also included mature-aged college entrants. A significant superiority for the pictorial mode of presentation was observed. Mature-aged entrants benefitted more from the CAI mode than ordinary entrants. A third study extended the research to include male students, both ordinary and mature-aged entrants, and confirmed the pictorial mode superiority previously noted. No significant sex differences were found with the CAI presentation. Observation of subjects who were involved in the three studies suggested that computers could perhaps be used to advantage in the diagnosis of arithmetic errors in children. A sequence of computerized diagnostic packages was designed which not only report on the child's success on the test, but also diagnose the errors being made, and suggest likely causes for these errors. These packages were trialled with primary school pupils of appropriate age and ability levels, and assessed by practicing teachers. Author

N90-24731*# Research Inst. for Advanced Computer Science, Moffett Field, CA.
A FAST, PRECONDITIONED CONJUGATE GRADIENT TOEPLITZ SOLVER
Victor Pan and Robert Schrieber (Rensselaer Polytechnic Inst., Troy, NY.) Mar. 1989 16 p Prepared in cooperation with City Univ. of New York, Bronx
(Contracts NCC2-387; N00014-86-K-0610; NSF CCR-88-05782; PSC-CUNY-668541; DAAL03-86-K-0112)
(NASA-CR-180367; NAS 1.26:180367; RIACS-TR-89.14) Avail: NTIS HC A03/MF A01 CSCL 09B

A simple factorization is given of an arbitrary hermitian, positive definite matrix in which the factors are well-conditioned, hermitian, and positive definite. In fact, given knowledge of the extreme eigenvalues of the original matrix A, an optimal improvement can be achieved, making the condition numbers of each of the two factors equal to the square root of the condition number of A. This technique is to applied to the solution of hermitian, positive definite Toeplitz systems. Large linear systems with hermitian, positive definite Toeplitz matrices arise in some signal processing applications. A stable fast algorithm is given for solving these systems that is based on the preconditioned conjugate gradient method. The algorithm exploits Toeplitz structure to reduce the cost of an iteration to O(n log n) by applying the fast Fourier Transform to compute matrix-vector products. Matrix factorization is used as a preconditioner. Author

N90-24732# Technische Univ., Eindhoven (Netherlands). Dept. of Mathematics and Computing Science.
SYNCHRONOUSLY PARALLEL BOLTZMANN MACHINES: A MATHEMATICAL MODEL
Patrick Zwietering and Emile Aarts (Philips Gloeilampenfabrieken N.V., Eindhoven, Netherlands) Aug. 1989 24 p
(MEMO-COSOR-89-21; ETN-90-96722) Avail: NTIS HC A03/MF A01

A mathematical model is presented. The description of synchronously parallel Boltzmann machines is performed. The model is based on the theory of Markov chains and combines a number of previously known results into one generic model. It is argued whether synchronously parallel Boltzmann machines maximize a function consisting of a weighted sum of the well-known consensus function and a pseudo consensus function. The weighting is determined by the amount of parallelism exploited in the Boltzmann machine and turns out to be problem dependent.
ESA

N90-24733*# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
ISIS AND META PROJECTS Progress Report
Kenneth Birman, Robert Cooper, and Keith Marzullo 22 Feb. 1990 14 p
(Contract NAG2-5937; N00140-87-C-8904; ARPA Order 6037)
(NASA-CR-186624; NAS 1.26:186624; AD-A219678; CU-CSD-TR-90-1103) Avail: NTIS HC A03/MF A01 CSCL 09/2

ISIS and META are two distributed systems projects at Cornell University. The ISIS project, led by Ken Birman, has developed a new methodology, virtual synchony, for writing robust distributed software. This approach is directly supported by ISIS Toolkit, a programming system that is distributed to over 300 academic and industrial sites. As the basic ISIS techniques have matured, we have focused increasingly on some of the remaining hard problems of reliable distributed programming. Principally these include high performance multicast, large scale applications, and wide area networks. We are also developing several interesting applications that exploit the strengths of ISIS, including an NFS-compatible replicated system. The META project, led by Keith Marzullo, is about distributed control in a soft real-time environment incorporating feedback. This domain encompasses examples as diverse as monitoring inventory and consumption on a factory floor, and performing load-balancing on a distributed computing system. One of the first uses of META is for distributed application management: the tasks of configuring a distributed program, dynamically adapting to failures, and monitoring its performance.
GRA

N90-24734# Wright Research Development Center, Wright-Patterson AFB, OH. Flight Dynamics Lab.
FLIPPER USER'S MANUAL Report, Mar. 1989
W. Z. Strang Jan. 1990 5 p
(AD-A220788; WRDC-TM-90-301) Avail: NTIS HC A01/MF A01 CSCL 12/5

Multi-block computational fluid dynamics solvers require a tremendous amount of input data before a solution can be obtained. This data primarily exists in two files when using the WRDC/FIMM developed multi-block Euler solver, MERCURY. The first contains the numerical grid while the other holds the boundary conditions and block connection information (the connectivity file). One is often interested in the asymmetrical flow about a symmetrical configuration. Rather than manually constructing the grid and connectivity datasets for a full, symmetric configuration, it is much more efficient to let a computer program automatically generate such datasets from the symmetric portion. FLIPPER is a computer program that reflects any MERCURY grid and boundary condition/connectivity information about they equals zero plane.
GRA

N90-24735# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
HIGHER ORDER ATTRIBUTE GRAMMARS
H. H. Vogt, S. D. Swierstra, and M. F. Kuiper Mar. 1989 18 p Presented at the ACM SIGPLAN 1989 Conference on Programming Language Design and Implementation
(RUU-CS-89-4; ETN-90-96769) Avail: NTIS HC A03/MF A01

A new kind of attribute grammars, called higher Order Attrbute Grammars (OAGs) is defined. In higher OAGs the structure tree can be expanded as a result of attribute computation. A structure tree may be stored in an attribute. A method, using OAGs is described to derive an evaluation order on the defining attribute occurrences which comprises all possible direct and indirect attribute dependencies. Visit-sequences are computed from which an efficient algorithm for attribute evaluation can be derived.
ESA

N90-24736# Argonne National Lab., IL. Mathematics and Computer Science Div.
ON THE PERFORMANCE OF ALGORITHMS FOR LARGE-SCALE BOUND CONSTRAINED PROBLEMS
Jorge J. More Feb. 1990 19 p Presented at the Workshop on Large-Scale Numerical Optimization, Ithaca, NY, 19-20 Oct. 1989
(Contract W-31-109-eng-38)
(DE90-010084; MCS-P140-0290-PPR; CONF-8910400-1) Avail: NTIS HC A03/MF A01

We discuss issues that affect the performance of algorithms for the solution of large-scale bound constrained problems on parallel computers. The discussion centers on the solution of the elastic-plastic torsion problem and the journal bearing problem. These two problems are model large-scale quadratic programming problems that arise as finite element approximations to elliptic variational inequalities. Performance issues are illustrated with the GPCG algorithm of More and Toraldo. This algorithm uses the gradient projection method to select an active set and the conjugate gradient method to explore the active set defined by the current iterate. We show that significant improvements in the performance of the GPCG algorithm can be obtained by using partitioning techniques in a parallel environment. We also show that these partitioning techniques lead to almost linear speedups on function-gradient evaluations and Hessian-vector products for partially separable functions.
DOE

N90-24737# Lawrence Livermore National Lab., CA.
PRECONDITIONED TIME-DIFFERENCING FOR THE PARALLEL SOLUTION OF THE HEAT EQUATION
Garry Rodrique and Donald Wolitzer (California State Univ., Hayward.) 1989 6 p Presented at the 4th SIAM Conference on Parallel Processing for Scientific Computing, Chicago, IL, 11-13 Dec. 1989 Submitted for publication
(Contract W-7405-eng-48)
(DE90-010636; UCRL-JC-103580; CONF-891273-5) Avail: NTIS HC A02/MF A01

In this paper we derive a new explicit difference method for solving the multidimensional heat equation. This method will be first order accurate in time and second order accurate in space and will have stability regions that are greater in size than the classical explicit Euler schemes. The motivation behind the development of new explicit methods is the fact that they can be efficiently carried out on vector and parallel computers. Thus, even though explicit methods are only conditionally stable, they may be more effective in use than the unconditionally stable implicit methods provided the stability intervals of the explicit methods are not too small.
DOE

N90-24738# Stanford Univ., CA. Systems Optimization Lab.
A BLOCK-LU UPDATE FOR LARGE-SCALE LINEAR PROGRAMMING
Samuel K. Eldersveld and Michael A. Saunders Jan. 1990 18 p
(Contract N00014-90-J-1242; NSF ECS-87-15153)
(AD-A219849; SU-SOL-90-2) Avail: NTIS HC A03/MF A01 CSCL 12/4

Stable and efficient updates to the basis matrix factors are vital to the simplex method. The best updating method depends

on the machine in use and how the update is implemented. For example, the classical product-form update can take advantage of the vector hardware on current supercomputers, and this helps compensate for its well known drawbacks. Conversely, the method of Bartels and Golub performs well on conventional machines, but is difficult to vectorize. With vectorization in mind, a method is examined based on the block-LU factors of an expanding basis. The partitioned matrix involved was introducted by Bisschop and Meeraus (1977, 1980). The update itself was proposed by Gill, Murray, Saunders and Wright (1984). The main advantages of the bloc-LU update are that it is stable, it vectorizes well, and compared to the product-form update, the nonzeros increase at about two thirds the rate. The update has been incorporated into MINOS and tested on 30 large, sparse linear programming problems. Results are given from runs on the Cray Y-MP. GRA

N90-24739# Naval Postgraduate School, Monterey, CA.
INTERCONNECTION OF THE GRAPHICS LANGUAGE FOR DATABASE SYSTEM TO THE MULTI-LINGUAL, MULTI-MODEL, MULTI-BACKEND DATABASE SYSTEM OVER AN ETHERNET NETWORK M.S. Thesis
Thomas Rivero Hogan Dec. 1989 136 p
(AD-A220081) Avail: NTIS HC A07/MF A01 CSCL 12/5

In recent years, the proliferation of database models required to meet today's ever changing database needs has led to a variety of Database Management System (DBMS) designs. This situation has presented a challenging problem for database managers. How does one access information from heterogeneous databases without having to learn and utilize the host's database model and language. The answer seems to lie in the area of multi-lingual, multi-model database systems. Such systems allow the user to access data from any database, using any language the user is familiar with, regardless of the model used to create the database. An experimental system has been developed and implemented at the Naval Postgraduate School in Monterey, California. One problem with the current system is the lack of a consistent and user-friendly interface to interact with the system. Many different visual interfaces for databases have been proposed in recent years, and one of the most promising is GLAD (Graphics Language for Database). GLAD utilizes direct manipulation of database objects through the use of buttons and other controls. The purpose of this thesis is to enhance the GLAD interface and allow it to transparently communicate with a backend data server, in this case ISI mini-computer running the Multi-Lingual, Multi-Model, Multi-Backend Database System (MBDS) software, allowing users to access heterogeneous databases in a simple and intuitive manner. GRA

N90-24740# Mitre Corp., Bedford, MA.
REAL TIME AUTOMATIC PROGRAMMING Final Technical Report, Oct. 1986 - Sep. 1987
Gary A. Cleveland, Richard L. Piazza, and Richard H. Brown Feb. 1990 41 p
(Contract F19628-87-C-0001)
(AD-A220162; RADC-TR-89-359) Avail: NTIS HC A03/MF A01 CSCL 12/5

This report describes the MITRE developed automatic programming system ISFI and the attempt to use this system in the production and modification of small to moderate sized real-time programs. ISFI is a knowledge-based automatic programming system that has been developed at MITRE during the past 5 years. The ISFI system is based upon the theory that networks of constraints are an appropriate knowledge representation tool for many domains, and illustrates a number of techniques such as propagation and transformation that facilitate inference in constraint networks as a method for code synthesis. GRA

N90-24741# Aerospace Corp., El Segundo, CA. Computer Science Lab.
EXPERIMENTAL HIGH SPEED/POWER RATIO ASIC DESIGNS USING RESIDUE NUMBERS Technical Report, Oct. 1985 - Sep. 1987
Arthur R. Simoneau, Jorge T. Pizarro, and Alice C. Parker 15 Mar. 1990 32 p
(Contract F04701-88-C-0089)
(AD-A220302; TR-0086(6920-03)-2; SSD-TR-90-11) Avail: NTIS HC A03/MF A01 CSCL 20/3

Residue numbers have traditionally been popular for signal processing applications and have recently received renewed interest, for a number of reasons. The inherent parallelism of the residue number system enables the throughput of a system to be increased while keeping the cost reasonable. With the advent of VLSI circuits, the increased size and complexity of parallel residue number circuits may no longer be prohibitive. A method for implementing onboard signal processing algorithms using CMOS Application Specific Integrated Circuits (ASIC) is presented. This method uses residue arithmetic in a one-out-of-n representation. The representation and implementation methods provide low-power circuits that retain their high-performance capabilities. Details of the adder and multiplier circuits are given, along with an overview of the input/output conversion logic. A specific example algorithm that performs a matrix multiplication has been chosen and implemented. Test chips of the adder demonstrate that the add function performs within our design constraints. Test chips of the algorithm for a particular residue have demonstrated that the arithmetic portions of the chip functioned as expected. Some preliminary results are included at the end of this report with some caveats regarding the particular implementation that we choose. GRA

N90-24742# Army Engineer Waterways Experiment Station, Vicksburg, MS. Information Technology Lab.
COMPUTER-AIDED STRUCTURAL ENGINEERING (CASE) PROJECT. USER'S GUIDE: A THREE-DIMENSIONAL STABILITY ANALYSIS/DESIGN PROGRAM (3DSAD). REPORT 2: GENERAL LOADS MODULE Instruction Report
Fred T. Tracy and Mary A. Leggett Sep. 1989 52 p Sponsored by Corps of Engineers, Washington, DC
(AD-A220331; WES/IR/ITL-87-38) Avail: NTIS HC A04/MF A01 CSCL 12/5

Computer program 3DSAD does an overturning and sliding stability analysis for complex three-dimensional structures. Specific structure types and general shapes can be handled. General modules are: geometry--to define, display, and compute mass properties; loads--to define, display, and compute loads; analysis--to perform a base analysis assuming a rigid body on an elastic foundation; and free-body--to use clipping capability for a free-body analysis. Geometry is defined by two-dimensional cross sections swept or grown linearly or axisymmetrically in third dimension, eight-node brick finite elements, and clusters of planar faces and bicubic patches. Loads are computed by giving a direction to a volume defined in the General Geometry Module format, specifying a point load, and simplifying load commands wherever soil and water levels are specified. Geometry and loads may be displayed by color wire-frame, hidden line, or continuous tone plots, and load cases may be defined. GRA

N90-24743# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Software Technology.
MULTIPLE INHERITANCE AND EXCEPTIONS IN FRAME SYSTEMS
Peter Lucas Aug. 1989 31 p
(CWI-CS-R8931; ETN-90-96802) Copyright Avail: NTIS HC A03/MF A01

The problem of handling contradictory information arising in frame systems with multiple inheritance is investigated. In the kind of frame systems described, a distinction is made between classes of objects and individual objects, called instances. Classes contain type information and initial attribute values, and are organized in a taxonomic hierarchy. The treatment focuses on inheritance of attribute values from classes to instances of classes. The method presented basically amounts to recording the reasoning that takes place in a frame taxonomy by means of so-called inheritance chains, and then applying a notion of in-betweenness to decide which attribute values derivable by means of inheritance should be given preference over others. An algorithm for constructing a

special kind of spanning tree for the associated directed graph of a frame taxonomy is described, and is proven to be equivalent to the canceling of inheritance chains by using in-betweenness. It is shown that in an inconsistent frame taxonomy such a spanning tree does not exist. ESA

N90-24744# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Software Technology.
SEQUENTIALITY IN ORTHOGONAL TERM REWRITING SYSTEMS
Jan Willem Klopt and Aart Middledorp Sep. 1989 41 p Revised Sponsored in part by EEC
(CWI-CS-R8932; CWI-CS-R8730; ETN-90-96803) Copyright Avail: NTIS HC A03/MF A01

For orthogonal term rewriting systems, G. Huet and J. Levy introduced the property of strong sequentiality. A strongly sequential orthogonal term rewriting system admits an efficiently computable normalizing one-step reduction strategy. As shown by Huet and Levy, strong sequentiality is a decidable property. An alternative analysis of strongly sequential term rewriting systems, leading to two simplified proofs of the decidability of this property is presented. Some related notions of sequentiality that were recently proposed are compared. ESA

N90-24745# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Software Technology.
MODULAR PARSER GENERATION
J. G. Rekers Sep. 1989 17 p Sponsored in part by EEC
(CWI-CS-R8933; ETN-90-96804) Copyright Avail: NTIS HC A03/MF A01

A parser generator (MPG) for grammars having a modular structure is considered. Each grammar module contains a partial or incomplete grammar, which has to be supplemented with the grammars defined by the modules imported in it. MPG generates a parser for each module by generating a parser for the union of a given set of modules in such a way that parsers for the individual modules can be selected from it. This yields a separate parser for each module which is efficient as a conventionally generated one, while the generation work invested in it can be reused for other modules. The generator works fully incrementally, as a modification of the grammar is propagated to all parsers whose generation depends on it. ESA

N90-24746# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
KNOWLEDGE GRAPHS AND NATURAL LANGUAGE
Cornelis Hoede and Mark Willems Oct. 1989 34 p
(MEMO-811; ISSN-0169-2690; ETN-90-96816) Avail: NTIS HC A03/MF A01

The theory of knowledge graphs, developed for the qualitative modeling of systems in medicine and social sciences, is extended in order to investigate its potential for the representation of natural language. Only six basic types of relations are used, next to the concept of frame. The theory of conceptual dependency of Schank is used as a background for the discussion. The present theory differs from the more general theory of conceptual graphs by Sowa in the sense that the graphs need not be bipartite. ESA

N90-24747# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
EXACT COLORING ALGORITHM FOR WEIGHTED GRAPHS APPLIED TO TIMETABLING PROBLEMS WITH LECTURES OF DIFFERENT LENGTHS
Mirjana Cangalovic (Belgrade Univ., Yugoslavia) and Jan A. M. Schreuder Oct. 1989 29 p
(MEMO-814; ISSN-0169-2690; ETN-90-96819) Avail: NTIS HC A03/MF A01

An exact algorithm for determining the interval chromatic number of a weighted graph is presented. The algorithm is based on enumeration and the branch-and-bound principle. Computational experiments with the application of the algorithm to random weighted graphs are given. The algorithm and its modifications are used for solving timetabling problems with lectures of different lengths. ESA

N90-24748# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
ON THE USE OF EQUATIONAL TYPE LOGIC FOR SOFTWARE ENGINEERING AND PROTOCOL DESIGN
Giuseppe Scollo Nov. 1989 27 p Presented at 1st Maghrebin Conference on Artificial Intelligence and Software Engineering, Constantine, Algeria, 24-27 Sep. 1989
(Memo-INF-89-52; ISSN-0923-1714; ETN-90-96844) Avail: NTIS HC A03/MF A01

Equational type logic is an extension of (conditional) equational logic, that widens equational reasoning towards reasoning with equations and type assignments. The pragmatics of this logic for software engineering are addressed. Topics of specification language design are proposed in the view of being engineering problems themselves. Protocol design is a software engineering activity, that is characterized by the distributed nature of the software system under design . How reasoning with equations and classifications works in a simple example, a game design problem, is demonstrated and a few analogies with design of communication protocols are pointed out. Future research directions are outlined in the conclusions. ESA

N90-24749# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
ON THE NOTION OF CURRYING
Jan Kuper Nov. 1989 19 p
(MEMO-INF-89-57; ISSN-0923-1714; ETN-90-96847) Avail: NTIS HC A03/MF A01

The mechanisms of currying and uncurrying are generalized towards higher order partial functions. A theory in which this generalization can be defined formally is introduced and the existence and uniqueness of curried versions of given functions is proved. The relation between currying and uncurrying is examined. ESA

N90-24750# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
MAJORITY VOTING: CHARACTERIZATION AND ALGORITHMS
H. Zantema Oct. 1988 15 p
(RUU-CS-88-32; ETN-90-96854) Avail: NTIS HC A03/MF A01

A complete characterization of the majority function on bags is given. A linear algorithm to compute it is derived. The algorithm is optimal with respect to the number of element comparisons. A very simple (n log k)-algorithm is given to find the set of k-majority elements of a bag with n elements. The rationale for each step in the characterization process is explained. It is concluded that to prove that the complexity of a loop consisting of n iterations is O(nf(n)), it is not always necessary to prove that the complexity of each iteration is O(f(n)). ESA

N90-24751# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
A SIMPLE OUTPUT-SENSITIVE ALGORITHM FOR HIDDEN SURFACE REMOVAL
Micha Sharir (New York Univ., New York.) and Mark H. Overmars Nov. 1989 13 p Sponsored by US Israeli Binational Science Foundation; Israeli National Council for Research and Development; and Israeli Academy of Sciences
(Contracts EC-3075; N00014-87-K-0129; NSF CCR-89-01484)
(RUU-CS-89-26; ETN-90-96877) Avail: NTIS HC A03/MF A01

A simple output-sensitive algorithm for hidden surface removal in a collection of n triangles is described. If k is the combinatorial complexity of the output visibility map, the method runs in time O(n(square root of k) log n). The method is extended to work for other classes of objects, sometimes with even improved time bounds. An algorithm that performs hidden surface removal for n (nonintersecting) balls in time O(n to the 3/2 power log n + k) is used as an example of one such application. ESA

N90-24752# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Interactive Systems.
ON THE PROJECTIVE INVARIANT REPRESENTATION OF CONICS IN COMPUTER GRAPHICS
Ivan Herman Oct. 1989 21 p Submitted for publication
(CWI-CS-R8938; ETN-90-96809) Copyright Avail: NTIS HC A03/MF A01

A general formulation for conics and conic arcs for the purpose of computer graphics is given, based on principles and theorems of projective geometry. This approach allows the approximation of these curves by line segments to be postponed in the graphics output pipeline; it results in a more compact storage, faster approximation algorithms and smoother outlook of the curves. ESA

N90-24753# Institute for Defense Analyses, Alexandria, VA.
THE ARMY/AIR FORCE RAMCAD (RELIABILITY AND MAINTAINABILITY COMPUTER-AIDED DESIGN) PROGRAM Progress Report, period ending Sep. 1989
G. Watts Hill and Frederick R. Riddell Jan. 1990 69 p
(Contract MDA903-89-C-0003)
(AD-A220923; AD-E501211; IDA-D-736; IDA/HQ-90-35154)
Avail: NTIS HC A04/MF A01 CSCL 13/8

The document encompasses RAMCAD studies at IDA between FY82 and FY89. The goal of RAMCAD is to design reliability and maintainability into a product rather than accept these characteristics as by-products of a design driven largely by performance criteria. The report focuses on the three (TRW Federal Systems, Boeing Computer Services, and General Dynamics' Convair Division), recipients of Army/Air Force RAMCAD Program software development contracts with emphasis on the work done by General Dynamics Convair Division. Recommendations for further research are discussed under Potential Avenues for Improvement. This document was written at the request of the U.S. Army Armament Research, Development, and Engineering Center (ARDEC) who are the co-sponsors of the General Dynamics RAMCAD Software Development Contract and have the responsibility for the technical direction of the contract. GRA

N90-24754# Electronics Research Lab., Salisbury (Australia).
SOME COMMENTS ON TECHNIQUES FOR RESISTING COMPUTER VIRUSES
M. Anderson Sep. 1989 27 p
(AD-A221097; ERL-0490-TR; DODA-AR-005-948) Avail: NTIS HC A03/MF A01 CSCL 12/5

Essentially, a computer virus is a code fragment which is implanted in a program to alter that program's function. For example assume the existence of some active virus program. The virus first searches for an executable file that is writeable. It then appends a copy of itself to some part of the code section, adds in a jump instruction to the usual entry point of the program, and then modifies that entry point to the virus code. Entry point addresses for programs in many computer systems can be obtained from what is generally dubbed the load module header residing in a known place of an executable file. The next time the program is invoked it ends up in the virus code which can then decide to reproduce further or to do something nasty (trigger). Figure 1 describes the basic flow control of many viruses. Variants on the virus theme include ones which modify their code structure before implantation or shift their position in the executable file. These tactics are intended to avoid detection by a program designed to track down the virus. Other types of viruses include those which are implanted on disks and are activated by the bootstrap programs on PC's. Computer viruses have caused concern in the information technology community. The basic protection mechanism of most machines is inadequate to deal with the virus problem, thus leaving them open to widespread corruption of data. GRA

N90-24755# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
DEVELOPMENT OF A POSTPROCESSING AND 3D GRAPHICAL IMAGING FACILITY Final Technical Report, 1 Dec. 1988 - 30 Nov. 1989
James G. Brasseur 31 Jan. 1990 6 p
(Grant AF-AFOSR-0139-89; AF Proj. 2307)
(AD-A221212; AFOSR-90-0374TR) Avail: NTIS HC A02/MF A01 CSCL 12/6

This grant supported the acquisition of equipment towards the development of what has been termed a Postprocessing and 3D Graphical Imaging Facility. The primary function of the facility is in the analysis of numerical and experimental data, perhaps created in other laboratories, through the combination of quantitative and graphical tools. Specifically, the motivation is the analysis of Full Numerical Simulations of turbulent flows to study time-dependent three-dimensional structural characteristics and the interrelationships among turbulent structures in different fluctuating variables. The hardware purchases towards these ends includes two Stardent Titan graphics mini-super-computers, one with 32 Mb memory and a single CPU, and the other with 64 Mb memory and two CPU's, both fully loaded with enhanced graphics, FORTRAN and C compilers and other software, nearly 3 Gb hard disk storage, a thermal color printer, a laser printer, and an X-terminal. The facility is fully networked as an Internet node. Some College matching funds remain. These will be combined with other funding sources to purchase hardware and software for the recording of animated sequences on video tape. GRA

N90-24756# Illinois Inst. of Tech., Chicago.
ACQUISITION OF AN ANALYTICAL X RAY AND IMAGE ANALYSIS SYSTEM Final Technical Report, 1 Dec. 1988 - 30 Nov. 1989
Philip Nash 5 Apr. 1990 6 p
(Grant AF-AFOSR-0116-89; AF Proj. 3842)
(AD-A221376; AFOSR-90-0424TR) Avail: NTIS HC A02/MF A01 CSCL 12/6

The list of equipment purchased is as follows: Princeton Gamma-Tech IMIX-IV system, camera/monitor package, remote workstation, PC with optical disk drive and printer, Ethernet interface for PC, stage motorization package, and peak wavelength spectrometer. Approximately 20 graduate students and several faculty from four different departments on campus have made use of the new equipment, with about 8 people using the equipment on a weekly basis. The equipment is operated on two 8 hour shifts Monday through Friday occasionally used on weekends. GRA

N90-24757# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
CONSTRUCTION OF AN ETHERNET MODEL WITH THE PROMISE SIMULATION TOOL
G. Wedzinga 7 Jul. 1988 36 p Presented at 1988 SCS Summer Computer Simulation Conference, Seattle, WA, 25-28 Jul. 1988
(NLR-MP-88047-U; ETN-90-96928) Avail: NTIS HC A03/MF A01

The construction and verification of an Ethernet model with the aid of PROMISE simulation tool is described. PROMISE is a general computer-based simulation tool developed for studying systems consisting of concurrent processes which exchange information via discrete signals. The Ethernet model consisting of two interconnected submodels is described. Both submodels are fully parametrized thus allowing all Ethernet parameters to be varied and giving a free choice of network configuration. ESA

N90-24758# Argonne National Lab., IL. Mathematics and Computer Science Div.
PARALLELIZING THE CLOSURE COMPUTATION IN AUTOMATED DEDUCTION
John K. Slaney (Australian National Univ., Canberra.) and Ewing L. Lusk 22 Nov. 1989 12 p Presented at the Computer Aided Deduction Conference, Kaiserslautern, Fed. Republic of Germany, 23-27 Jul. 1990
(Contract W-31-109-eng-38)
(DE90-007792; CONF-900765-1) Avail: NTIS HC A03/MF A01

A parallel algorithm is presented for computing the closure of a set under an operation. This particular type of computation

appears in a variety of disguises, and has been used in automated theorem proving, abstract algebra, and formal logic. The algorithm given here is particularly suited for shared-memory parallel computers, where it makes possible economies of space. Implementations of the algorithm in two application contexts are described and experimental results given. DOE

N90-24759# Argonne National Lab., IL. Computing and Telecommunications Div.

CERC (CENTER FOR ENERGY RESEARCH COMPUTATION) REPORT: RESULTS OF THE CERC PROJECT WITH RECOMMENDATIONS FOR ANL (ARGONNE NATIONAL LABORATORY) INSTITUTIONAL STRATEGIES IN ADVANCED SCIENTIFIC COMPUTING

Charles J. Mueller, Clifford M. Caruthers, Wayne R. Cowell, William A. Ellingson, Thomas F. Ewing, Fred M. Moszur, Robert J. Harrison, David W. Leibfritz, David M. Malon, and Edward N. May et al Jan. 1990 90 p

(Contract W-31-109-eng-38)

(DE90-008238; ANL/TM-475) Avail: NTIS HC A05/MF A01

Areas of discussion are: investigations in computational science applications at Argonne; software tools for analysis and transformation of FORTRAN programs; scientific visualization projects and demonstrations; and institutional strategies in advanced scientific computing. DOE

N90-24760# Los Alamos National Lab., NM. Center for Computer Security.

GRAPH STRUCTURE MODEL

Jared S. Dreicer 1990 5 p Presented at the 7th International Conference on Systems Engineering, Las Vegas, NV, 18-20 Jul. 1990

(Contract W-7405-eng-36)

(DE90-008945; LA-UR-90-771; CONF-900781-1) Avail: NTIS HC A01/MF A01

The Graph Structure (GRPHSTRUC) Model is a software system tool specifically developed to be used by a computer security analyst to study the security and analyze the design of computer networks. However, any system that can be characterized and represented by a graph structure could employ GRPHSTRUC with some minor system modifications. The GRPHSTRUC model is a knowledge-based expert system using icons and object-oriented programming methodologies. GRPHSTRUC has been designed and developed to use classical graph theory and allow the display of components and links of a graph structure. A graph G = (V,E) is a structure that consists of a finite set of vertices V and a finite set of edges E. A computer network is a graph structure; the vertices are the components of the network and the edges are the links between components. The GRPHSTRUC model provides a user interface that is designed to give a user the ability to rapidly and efficiently represent graph components, connections, and relationships. DOE

N90-24761# Lawrence Livermore National Lab., CA.

HUGOFIT AND HUGOPLOT: COMPUTER CODES FOR PLANE SHOCK WAVE ANALYSIS WITH MATERIALS THAT HAVE NON-SIMPLE HUGONIOTS

G. Roger Gathers 25 Jan. 1990 61 p

(Contract W-7405-eng-48)

(DE90-010284; UCRL-ID-103346) Avail: NTIS HC A04/MF A01

These two codes were written to accommodate plane shock wave data analysis and prediction for materials which are not adequately described by a simple linear u(sub s)-u(sub p) Hugoniot fit. As an example, kapton is a common flyer used in electric guns and falls into the above class of materials. The best tabulated data for its Hugoniot known to the author is that of Marsh (polyimide). The best fit can be obtained using a series of linear segments in the u(sub s)-u(sub p) plane. This is characteristic of materials that undergo phase changes on the Hugoniot. A substantial database for the EOS (equation of state) of many materials also exists at LLNL. The HUGOFIT code was written so that Hugoniots from that database (after conversion of units) could be readily fitted. The EOP library results are available on the mainframe computers at LLNL and the availability of graphics on these machines (and absence of graphics on the author's PC) made it simplest to write the codes for use on the mainframes. An added advantage is the ability to put out hardcopy to either fiche or RJET. The codes are written for the CRAY-1, but there is no intrinsic reason the codes cannot be adapted to a PC, and this is currently being done. One can also readily use tables of experimental data. The data to be fitted is entered from a file on disk called DATA. All other input is made from the teletype. The units for velocity were chosen to be km/sec since that is what the EOP library uses. Densities are in g/cu cm and pressures are in megabars. DOE

N90-24762# Oak Ridge National Lab., TN.

INPUT/OUTPUT ALGORITHM FOR M-DIMENSIONAL RECTANGULAR DOMAIN DECOMPOSITIONS ON N-DIMENSIONAL HYPERCUBE MULTICOMPUTERS

Hugo Embrechts (Katholieke Univ. te Leuven, Belgium) and Judson P. Jones 1990 8 p Presented at the 5th Distributed Memory Computing Conference, Charleston, SC, 9-12 Apr. 1990

(Contract DE-AC05-84OR-21400)

(DE90-010494; CONF-9004159-4) Avail: NTIS HC A02/MF A01

Hypercube-topology concurrent multicomputers owe at least part of their popularity to the fact that it is relatively simple to decompose rectangularly-shaped M-dimensional domains into subdomains and assign these subdomains to processors (PEs) in a manner which preserves the adjacencies of the subdomains. However, this decomposition involves some arrangement of the data during input/output operations to (linear memory) data acquisition, display, or mass storage devices. It is shown that this rearrangement can be done efficiently, in parallel. The main consequence of this algorithm is that M-dimensional data can be stored in a simple, general format and yet be communicated efficiently independent of the dimension of the hypercube or the number of these dimensions assigned to the dimensions of the domain. This algorithm is also relevant to applications with mixed domain decompositions, and to parallel mass storage media such as disk farms. DOE

N90-24763# Oak Ridge National Lab., TN. Mathematical Sciences Section.

VISUAL ANIMATION OF PARALLEL ALGORITHMS FOR MATRIX COMPUTATIONS

Michael T. Heath 1990 10 p Presented at the 5th Distributed Memory Computing Conference, Charleston, SC, 9-12 Apr. 1990

(Contract DE-AC05-84OR-21400)

(DE90-011076; CONF-9004159-7) Avail: NTIS HC A02/MF A01

It is shown how graphical animation of the behavior of parallel algorithms can facilitate the design and performance enhancement of algorithms for matrix computations on parallel computer architectures. Using a portable instrumented communication library and a graphical animation package developed at Oak Ridge National Laboratory, the effects are illustrated of various strategies in parallel algorithm design, including interconnection topologies, global communication patterns, data mapping schemes, load balancing, and pipelining techniques for overlapping communication with computation. Distributed-memory parallel architectures in which the processors communicate by passing messages are the focus. The linear algebra problems considered include matrix factorization and the solution of triangular systems. DOE

N90-24764# Lawrence Livermore National Lab., CA.

PARALLEL ALGORITHMIC METHODS FOR VOLUMETRIC RENDERING Final Report, 1 Mar. - 30 Sep. 1989

Kenneth I. Joy (California Univ., Davis.) Feb. 1990 21 p

(Contract W-7405-eng-48)

(DE90-011326; UCRL-CR-103858) Avail: NTIS HC A03/MF A01

The visualization of multi-dimensional, multi-channel data is an essential task for the solution of many scientific and engineering

problems. Scientific visualization, which allows people to interact with and manipulate graphical representations of otherwise raw data obtained from simulations and experiments provides increased comprehension of the true nature of the data. As data sets increase in size, dimension and complexity, however, the need for new visualization techniques becomes immediately apparent. In particular, it is necessary to address the following visualization problems: techniques to address the rendering of three-dimensional data sets and techniques to address interactive visualization of data. The results of this work have been published in a separate report which is attached to this report. DOE

N90-24326# Fabrica Italiana Apparecchiature Radioelettriche S.p.A., Milan.
COLLISION DETECTION USING LINEAR PROGRAMMING
R. Gallerini and A. Sciomachen (Milan Univ., Italy) *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 367-372 (For primary document see N90-24280 18-12)
Copyright Avail: NTIS HC A19/MF A03; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders

N90-24364*# Wentworth Inst., Boston, MA.
DEMO OF THREE WAYS TO USE A COMPUTER TO ASSIST IN LAB
J. P. Neville *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 101-104 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 09B

N90-24368*# San Jose State Univ., CA.
MANUAL AND COMPUTER-AIDED MATERIALS SELECTION FOR INDUSTRIAL PRODUCTION: AN EXERCISE IN DECISION MAKING
Seth P. Bates *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 133-139 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 09B

N90-25036*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
INCORPORATION OF A PROGRESSIVE FAILURE ANALYSIS METHOD IN THE CSM TESTBED SOFTWARE SYSTEM
Robert T. Arenburg *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 41-45 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 09B

N90-25038*# University of Central Michigan, Mount Pleasant. Dept. of Computer Science.
A FEW MODELING AND RENDERING TECHNIQUES FOR COMPUTER GRAPHICS AND THEIR IMPLEMENTATION ON ULTRA HARDWARE Abstract Only
Hari Bidasaria *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 48-49 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 09B

N90-25050*# Elizabeth City State Univ., NC. Dept. of Mathematics and Computer Science.
THE IMPLEMENTATION OF THE GRAPHICS OF PROGRAM EAGLE: A NUMERICAL GRID GENERATION CODE ON NASA LANGLEY SNS COMPUTER SYSTEM Abstract Only
Johnny L. Houston *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 84-85 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 09B

N90-25056*# Elizabeth City State Univ., NC. Dept. of Technology.
A USER-FRIENDLY, MENU-DRIVEN, LANGUAGE-FREE LASER CHARACTERISTICS CURVES GRAPHING PROGRAM FOR DESK-TOP IBM PC COMPATIBLE COMPUTERS
Glenn Klutz *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 103-104 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N90-24765# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
EMBEDDED DIAGONALLY IMPLICIT RUNGE-KUTTA ALGORITHMS ON PARALLEL COMPUTERS
P. J. vanderHouwen, B. P. Sommeijer, and W. Couzy Jun. 1989 22 p
(CWI-NM-R8912; ETN-90-96739) Copyright Avail: NTIS HC A03/MF A01

Diagonally implicit Runge-Kutta methods are investigated. In these methods the implicit relations can be solved in parallel and singly diagonally implicit on each processor. The algorithms are based on diagonally implicit iteration of fully implicit Runge-Kutta methods. The iteration scheme is chosen in such a way that the resulting algorithm is A (alpha)-stable or L(alpha)-stable with alpha equal or very close to pi/2. Embedded formulas of lower orders are automatically available allowing a strategy for step and order variation. ESA

N90-24766# Naval Postgraduate School, Monterey, CA.
SENSITIVITY ANALYSIS OF TRANSPUTER WORKFARM TOPOLOGIES M.S. Thesis
Timothy J. Johnson Sep. 1989 79 p
(AD-A219821) Avail: NTIS HC A05/MF A01 CSCL 12/7

Parallel processing structures such as multiprocessor arrays and pipelining enhance throughput tremendously for suitable algorithms having high degrees of concurrency. However, if the time to process different workpackets becomes irregular, much of the advantage offer traditional sequential processing systems may be lost. In an attempt to produce a more flexible response to workload demands, a transputer workfarm was investigated. Two network topologies, a linear model and a tree model were built using the transputer as the processing element (PE), or worker. An algorithm was developed which could be run independently on all workers in the workfarm. Each worker produced results independent of the other workers. By altering specific variables within the algorithm, the network performance could be changed. The results from this thesis illustrate how these parameters affect each network and provide comparative information between the linear model and the tree model. GRA

N90-24767*# Santa Clara Univ., CA. Dept. of Electrical Engineering and Computer Science.
PERFORMANCE ANALYSIS OF LOCAL AREA NETWORKS Final Report
Hasan S. AlKhatib and Mary Grace Hall 9 Jul. 1990 99 p
(Contract NCC2-554)
(NASA-CR-186639; NAS 1.26:186639) Avail: NTIS HC A05/MF A01 CSCL 09B

A simulation of the TCP/IP protocol running on a CSMA/CD data link layer was described. The simulation was implemented using the simula language, and object oriented discrete event language. It allows the user to set the number of stations at run time, as well as some station parameters. Those parameters are the interrupt time and the dma transfer rate for each station. In addition, the user may configure the network at run time with stations of differing characteristics. Two types are available, and

the parameters of both types are read from input files at run time. The parameters include the dma transfer rate, interrupt time, data rate, average message size, maximum frame size and the average interarrival time of messages per station. The information collected for the network is the throughput and the mean delay per packet. For each station, the number of messages attempted as well as the number of messages successfully transmitted is collected in addition to the throughput and mean packet delay per station. Author

N90-24768# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
RESULTS OF THE REALAN PROJECT: REPLACING THE ETHERNET ACCESS MECHANISM BY THE REAL-TIME ACCESS MECHANISM OF TWENTENET
Aiko Pras Nov. 1989 19 p Submitted for publication
(MEMO-INF-89-55; ISSN-0923-1714; ETN-90-96845) Avail: NTIS HC A03/MF A01

Based on the example of REALAN, the use of a LAN access mechanism (MAC protocol) designed for a specific type of physical service on top of another type of physical service is discussed. In the REALAN example, an Ethernet physical layer is used to provide service to the Twentenet realtime access mechanism. Relevant Ethernet and Twentenet concepts are introduced and the approach taken, the problems that were encountered plus the actual synthesis of both networks, are described. In the example used, the access mechanism expected a different type of underlying service than the one offered by the physical service provider. An enhancement layer was needed to align this mismatch. ESA

N90-24769# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
THE ONE DIMENSIONAL SKEWING PROBLEM
Gerard Tel, J. vanLeeuwen, and H. A. G. Wijshoff (Illinois Univ., Urbana.) Oct. 1989 22 p Revised
(Contract EC-3075)
(RUU-CS-89-23; RUU-CS-86-8; ETN-90-96875) Avail: NTIS HC A03/MF A01

The simplest case of skewing an (infinite) one dimensional array, so that cells that are connected according to a given data template T are mapped in different banks, is analyzed. Upper and lower bounds for the minimum number of memory banks in which this can be done in the general case are derived. An extra upper bound for the special case of (k,l,m) templates is derived. Additional results are proved for natural classes of templates which are indicative for the combinatorial complexity of the problem. ESA

N90-24770# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Algorithms and Architecture.
EXPERIENCES WITH THE AMOEBA DISTRIBUTED OPERATING SYSTEM
Andrew S. Tanenbaum, Robbert vanRenesse, Hans vanStaveren, Gregory J. Sharp (Vrije Univ., Amsterdam, Netherlands), Sape J. Mullender, Jack Jansen, and Guido vanRossum Aug. 1989 24 p Sponsored in part by Digital Equipment Corp.
(Grant NWO-125-30-10)
(CWI-CS-R8929; ETN-90-96800) Copyright Avail: NTIS HC A03/MF A01

The Amobea distributed operating system, in development and use for over eight years, is studied. The current version of the system is described in some detail, as it has evolved considerably since the first publication about it. Those aspects of the system considered novel, interesting, and not present in many other systems of its type, are emphasized. The measured performance of Amoeba is compared to the performance of other systems. A number of the critical design choices made, and those considered successful and unsuccessful are pointed out. ESA

N90-24771# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Algorithms and Architecture.
AMOEBA: HIGH PERFORMANCE DISTRIBUTED COMPUTING
Sape J. Mullender, Guido vanRossum, Andrew S. Tanenbaum, Robbert vanRenesse, and Hans vanStaveren (Vrije Univ., Amsterdam, Netherlands) Oct. 1989 16 p Sponsored by Netherlands Organization for Scientific Research; SION; Foundation for Computer Science Research; and Digital Equipment Corp.
(CWI-CS-R8937; ETN-90-96808) Copyright Avail: NTIS HC A03/MF A01

An overview and an explanation of the design of the Amoeba distributed system as it is today is presented. Amoeba is an object-based distributed system using capabilities for protection and naming. Objects are managed by a service and objects are named using capabilities chosen randomly from a sparse name space. Processes consist of a segmented address space and one or more threads of control. Processes can be created, managed and debugged remotely and processes may migrate at any point during their execution. Remote operations are used for interprocess communication. The principal file system offers an immutable-file interface with caching in the file server's main memory. The directory server maps path names to capabilities and allows atomic update of sets of mappings, obviating a separate transaction management system. Most applications written for Unix can be run on Amoeba without change with the help of an emulation server. Programs that use the more obscure features of Unix must often be changed or rewritten. ESA

N90-24772# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Algorithms and Architecture.
HOW TO CONSTRUCT AN ATOMIC VARIABLE
John T. Tromp Oct. 1989 26 p Submitted for publication
(CWI-CS-R8939; ETN-90-96810) Copyright Avail: NTIS HC A03/MF A01

Solutions to the problem of simulating an atomic single-reader, single writter variable with non-atomic bits are presented. The first construction, for the case of a 2-valued atomic variable (bit), achieves the minimal number of non-atomic bits needed. The main construction of a multi-bit variable avoids repeated writing (respectively reading) of the value in a single write (respectively read) action on the simulated atomic variable. It improves on existing solutions of that type in simplicity and in the number of non-atomic bits used, both in presence and in accesses per read/write action. The verification of these constructions by machine, based on atomicity-testing automata, is shown. ESA

N90-24773# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik.
ICONIC TRACKING ALGORITHMS FOR HIGH ENERGY PHYSICS USING THE TRAX-I MASSIVELY PARALLEL PROCESSOR
G. Vesztergombi Nov. 1989 23 p
(MPI-PAE/Exp.El-216; ETN-90-96968) Copyright Avail: NTIS HC A03/MF A01

The cost-effective TRAX-I parallel microcomputer is described. It combines associative string processor architecture with 16K parallel processing elements. Applications of the microcomputer to the tracking of very complex events with several hundred tracks are described. The large number of processors allows one to dedicate one or more processors to each wire, each pixel, or each pad. This allows for very efficient pattern recognition. Some linear tracking algorithms based on this iconic representation are presented. ESA

N90-24774# Illinois Univ., Urbana. Dept. of Computer Science.
POTENTIAL PERFORMANCE OF METHODS FOR PARALLELISM ACROSS TIME IN ODES
Xuhai Xu and C. W. Gear Jan. 1990 40 p
(Contract DE-FG02-87ER-25026; NSF DMS-87-03226)
(DE90-010992; DOE/ER-25026/35; UIUCDCS-R-90-1587; UILU-ENG-90-1726) Avail: NTIS HC A03/MF A01

An earlier report described a possible approach to massive parallelism across time. Some numerical experiments on the method are described along with two modifications to the method to increase the parallelism and improve the behavior for nonlinear stiff problems. DOE

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N90-24775# Brown Univ., Providence, RI. Center for Neural Science.
A NEURAL NETWORK FOR FEATURE EXTRACTION
Nathan Intrator 9 Apr. 1990 9 p Submitted for publication
Sponsored in part by NSF and ARO
(Contract N00014-86-K-0041)
(AD-A220363; AD-E501205; TR-53) Avail: NTIS HC A02/MF A01 CSCL 12/9

The paper suggests a statistical framework for the parameter estimation problem associated with unsupervised learning in a neural network, leading to an exploratory projection pursuit network that performs feature extraction, or dimensionality reduction. GRA

N90-24776# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
ON THE THEORY OF NONLINEAR CONTROL SYSTEMS
H. Nijmeijer Oct. 1989 22 p Repr. from Three Decades of Mathematical System Theory (H. Nijmeijer and J. M. Schumacher, Springer-Verlag, Berlin, Federal Rep. of Germany) 1989 p 339-357
(MEMO-813; ISSN-0169-2690; ETN-90-96818) Avail: NTIS HC A03/MF A01

A review of some of the recent advances in nonlinear control theory is presented. A central theme in the discussion is the notion of state feedback and its use for altering the structural properties of a system. The relations between various synthesis problems, controlled invariance and a general decomposition problem are investigated. ESA

N90-24777# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
PROGRESS IN THE POLYNOMIAL SOLUTION OF THE STANDARD H-INFINITY OPTIMAL CONTROL PROBLEM
Huibert Kwakernaak Oct. 1989 41 p
(MEMO-817; ISSN-0169-2690; ETN-90-96822) Avail: NTIS HC A03/MF A01

The polynomial solution of the standard H infinity optimal control problem is presented. Recent results in this area are summarized. By J-spectral factorization a pair of matrix polynomial equations is obtained, one linear, the other quadratic. The solution of the optimal control problem is reduced to finding a suitable solution of these equations. ESA

N90-24778# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
ALMOST INPUT-OUTPUT DECOUPLING WITH STABILITY
W. Respondek, A. J. vanderSchaft, and R. Marino (Rome Univ., Italy) Nov. 1989 12 p
(MEMO-819; ISSN-0169-2690; ETN-90-96824) Avail: NTIS HC A03/MF A01

Previous work on a singular perturbation approach to almost decoupling problems is extended by identifying those linear systems which can be almost input-output decoupled (approximately input-output decoupled to any desired degree of accuracy) with internal stability. Using the Morse canonical form it is shown that for an almost input-output decouplable system a set of fixed almost modes can be defined, and that almost input-output decoupling together with internal stability can be achieved if and only if this set is contained in the open left half plane of the complex plane. It is explained how this notion of fixed almost modes generalizes the well-known notion of fixed modes for an input-output decouplable system. ESA

N90-24779# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
INTELLIGENT TUTORING SYSTEMS: AN EXPLORATORY STUDY OF ITS AND THEIR IMPLEMENTATION IN PROLOG [INTELLIGENTE ONDERWIJSSYSTEMEN: EEN VERKENNEND ONDERZOEK NAAR INTELLIGENTE ONDERWIJSSYSTEMEN EN IMPLEMENTATIE DAARVAN IN PROLOG]
Paul Bergervoet Dec. 1988 62 p In DUTCH
(RUU-CS-88-37; ETN-90-96858) Avail: NTIS HC A04/MF A01

Intelligent Tutoring Systems (ITS) were investigated, with emphasis on the teaching of formula manipulation and the concomitant algorithms. The characteristics of ITS are discussed. The existing systems are surveyed. The development of diagnostic systems is very complex; it is therefore recommended to limit the development to a diagnostic system for errors in algebra. The development of intelligent diagnostic systems in PROLOG is outlined. ESA

N90-24780# Neurogen, Brookline, MA.
ADAPTIVE CONTROL OF VISUALLY GUIDED GRASPING IN NEURAL NETWORKS Final Report, 1 Jan. - 31 Dec. 1989
Michael Kuperstein 12 Mar. 1990 25 p
(Grant AF-AFOSR-0030-89; AF Proj. 2313)
(AD-A221387; AFOSR-90-0420TR) Avail: NTIS HC A03/MF A01 CSCL 12/9

A theory and prototype is presented of a neural controller called INFANT that learns sensory-motor coordination from its own experience. INFANT adapts to unforeseen changes in the geometry of the physical motor system and to the location, orientation, shape and size of objects. It can learn to accurately grasp an enlongated object without any information about the geometry of the physical sensorimotor system. This new neural controller relies on the self-consistency between sensory and motor signals to achieve unsupervised learning. It is designed to be generalized for coordinating any number of sensory inputs with limbs of any number of joints. The simulation model was implemented with real targets and movements using two stereo TV cameras and a multijoint manipulator. The theory of sensorimotor coordination was extended from single movements to movement sequences. The neural network controller in the proposed study has a number of application benefits. The controller will deal effectively in novel working environments such as in space because of its ability to deal with unforeseen changes in the mechanical plant and actuators. Its adaptability will allow continuous self-calibration and its genetic design will allow it to be implemented in many different robots. The parallel feedforward control architecture will make robot control very fast and the overlapping modifiable neural weights will allow fault tolerance. This will greatly reduce tooling costs, setup time and failure in unforseen environments. GRA

N90-24984*# Houston Univ., TX. Dept. of Psychology.
THE DEVELOPMENT OF EXPERTISE ON AN INTELLIGENT TUTORING SYSTEM Final Report
Debra Steele Johnson *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 14 p
(For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 09B

N90-24991*# Pittsburgh Univ., PA. Dept. of Information Science.
A COMPARISON OF TWO NEURAL NETWORK SCHEMES FOR NAVIGATION Final Report
Paul W. Munro *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 10 p
(For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 09B

N90-25071*# Duke Univ., Durham, NC. Dept. of Electrical Engineering.
MARS ROVER IMAGING SYSTEMS AND DIRECTIONAL FILTERING
Paul P. Wang *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship

Program 1989 Sep. 1989 p 155-158 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 22B

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N90-24781# Teleos Research, Palo Alto, CA.
INTELLIGENT REAL-TIME PROBLEM-SOLVING: ISSUES, CONCEPTS AND RESEARCH METHODOLOGY Final Report, Aug. - Nov. 1989
Stanley J. Rosenschein, Michael Fehling, Matthew L. Ginsberg, Eric J. Horvitz, and Bruce D. DAmbrosio (Oregon State Univ., Corvallis.) 25 Jan. 1990 41 p
(Contract F49620-89-C-0117)
(AD-A218868; TR/90-01; AFOSR-90-0237TR) Avail: NTIS HC A03/MF A01 CSCL 12/7

The Air Force sponsored a study aimed at laying out research issues in the area of intelligent real time problem solving. As part of this study, a team has reviewed topics in this area and has participated in a workshop. A position statement of the Teleos team prepared for that workshop is presented along with a discussion of the research issues panel held at the workshop itself and of methodologies for evaluating intelligent real-time problem solving systems. GRA

N90-24782# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A COMPARISON OF VARIANCE-CONTROLLED AND NON-CONTROLLED PRINCIPAL COMPONENTS M.S. Thesis
Marie Angelique N. Demandante Mar. 1990 105 p
(AD-A220530; AFIT/GOR/ENS/90M-4) Avail: NTIS HC A06/MF A01 CSCL 12/3

The purpose of this thesis was to examine the effects of applying the technique of control variates on the principal components of a given model. The investigation was done by comparing three sets of data: (1) The set of principal components of the outputs of the model on which no variance reduction has been applied; (2) The set of principal components of variance-controlled outputs-control variates was performed prior to principal components analysis being done; (3) The set of variance-controlled principal components-control variates was performed on the principal components of the outputs. The comparison of the effects was carried out by examining the percentage of variance explained by the principal components and by reviewing the scatter plots of the first two principal components. GRA

N90-24783# Washington Univ., Seattle. Dept. of Applied Mathematics.
SUSTAINED RESONANCE IN VERY SLOWLY VARYING OSCILLATORY HAMILTONIAN SYSTEMS
D. L. Bosley and J. Kevorkian Mar. 1990 56 p
(Contract DE-FG06-86ER-25019)
(DE90-010422; DOE/ER-25019/15) Avail: NTIS HC A04/MF A01

By formulating slowly varying oscillatory systems into Hamiltonian standard form, canonical averaging techniques can be performed automatically by symbolic manipulation programs to very high orders. For the very slow variation considered, these high orders are required to find uniformly valid solutions. When resonance is exhibited in these systems, the original system of 2N first order differential equations is reduced to two differential equations which embody the resonance behavior. Sustained resonance, also referred to as phase locking, occurs when the leading order frequency of the reduced system oscillates about zero for long times. The general solution procedure is illustrated, and a highly accurate asymptotic solution is found explicitly for a frequently occurring class of problems, which results when only a single harmonic of the resonance is present. This solution was not possible for the same class of problems with the usual slow time. Two test cases are considered to numerically verify all results. DOE

N90-24784# Argonne National Lab., IL. Mathematics and Computer Science Div.
THE HK SINGULAR VALUE DECOMPOSITION OF RANK DEFICIENT MATRIX TRIPLETS
L. Magnus Ewerbring and Franklin T. Luk (Cornell Univ., Ithaca, NY.) 1989 7 p Presented at the 1st Great Lakes Computer Science Conference, Kalamazoo, MI, 18-20 Oct. 1989
(Contracts W-31-109-eng-38; DAAL03-86-K-0109)
(DE90-010114; CONF-8910401-1) Avail: NTIS HC A02/MF A01

In this paper we consider a simultaneous reduction of three matrices. The described method is extended from previous work to include rank deficient data. It is shown how, via an initial reduction, the problem becomes one of diagonalizing a product of three matrices. We compare three different algorithms for its computation and show why one is preferred over the others. DOE

N90-24785# Argonne National Lab., IL. Mathematics and Computer Science Div.
GROUND STATES OF SEMI-LINEAR DIFFUSION EQUATIONS
Hans G. Kaper and Man Kam Kwong 1989 8 p Presented at the Workshop on Differential Equations and Applications, Retzhof, Austria, 18-24 Jun. 1989
(Contract W-31-109-eng-38)
(DE90-010419; CONF-8906317-1) Avail: NTIS HC A02/MF A01

The uniqueness was studied of nontrivial nonnegative solutions of semilinear diffusion equations of the type (Delta)u + (line integral)(u) = 0 in radially symmetric domains in R(sup N) (N (greater than or = 2), where (line integral) is defined and continuous on (0, (infinity)) and Lipschitz continuous on (0, (infinity)), with (line integral)(0) = 0. DOE

N90-24786# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
DETERMINATION OF ALGORITHM PARALLELISM IN NP COMPLETE PROBLEMS FOR DISTRIBUTED ARCHITECTURES M.S. Thesis
Ralph Andrew Beard Mar. 1990 234 p
(AD-A220192; AFIT/GCE/ENG/90M-1) Avail: NTIS HC A11/MF A02 CSCL 12/5

The purpose of this thesis is to explore the methods used to parallelize NP-complete problems and the degree of improvement that can be realized using a distributed parallel processor to solve these combinatoric problems. Common NP-complete problem characteristics such as a priori reductions, use of partial-state information, and inhomogeneous searches are identified and studied. The set covering problem (SCP) is implemented for this research because many applications such as information retrieval, task scheduling, and VLSI expression simplification can be structured as an SCP problem. In addition, its generic NP-complete common characteristics are well documented and a parallel implementation has not been reported. Parallel programming design techniques involve decomposing the problem and developing the parallel algorithms. The major components of a parallel solution are developed in a four phase process. First, a meta-level design is accomplished using an appropriate design language such as UNITY. Then, the UNITY design is transformed into an algorithm and implementation specific to a distributed architecture. Finally, a complexity analysis of the algorithm is performed. The a priori reductions are divided-and-conquer algorithms; whereas, the search for the optimal set cover is accomplished with a branch-and-bound algorithm. The search utilizes a global best cost maintained at a central location for distribution to all processors. Three methods of load balancing are implemented. GRA

N90-24787# Stanford Univ., CA. Dept. of Operations Research.
A LYAPUNOV BOUND FOR SOLUTIONS OF POISSON'S EQUATION
Peter W. Glynn Nov. 1989 17 p
(Contract DAAL03-88-K-0063)
(AD-A220223; TR-46; ARO-25839.22-MA) Avail: NTIS HC A03/MF A01 CSCL 12/3

Suppose that X is a positive recurrent Harris chain with invariant measure pi. A Lyapunov function criterion was developed that permits one to bound the solution g to Poisson's equation for X. This bound is then applied to obtain sufficient conditions that guarantee that the solution be an element of L sub p (pi). When p = 2, the square integrability of g implies the validity of a functional central limit theorem for the Markov chain. The technique was illustrated with applications to the waiting time sequence of the single-server queue and autoregressive sequences. GRA

N90-24788# Stanford Univ., CA. Dept. of Operations Research.
UNIFORM LIMIT THEOREMS FOR SYNCHRONOUS PROCESSES WITH APPLICATIONS TO QUEUES
Peter W. Glynn and Karl Sigman (Columbia Univ., New York, NY.) Oct. 1989 18 p Sponsored in cooperation with the Natural Sciences of Engineering Research Council of Canada
(Contract DAAL03-88-K-0063; NSF DDM-89-57825)
(AD-A220224; TR-44; ARO-25839.20-MA) Avail: NTIS HC A03/MF A01 CSCL 12/4

Conditions were investigated under which the Cesaro averaged functionals are investigated. It was shown that to obtain uniform convergence requires placing further conditions on the Positive Recurrence Process (PRS). This is in sharp contrast to both classical regenerative processes and discrete time Harris recurrent Markov chains (where renewal theory can be applied) where such uniform convergence holds without any further conditions. For continuous time positive Harris recurrent Markov processes (where renewal theory can not be applied) it is shown that these further conditions are in fact automatically satisfied. In this context, applications to queueing models are given. GRA

N90-24789# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Software Engineering.
DESIGN OF A SPECIFICATION LANGUAGE BY ABSTRACT SYNTAX ENGINEERING
J. C. M. Baeten and J. A. Bergstra (Amsterdam Univ., Netherlands) Sep. 1989 31 p Sponsored in part by EEC
(CWI-CS-R8934; ETN-90-96805) Copyright Avail: NTIS HC A03/MF A01

A specification language is designed in an entirely algebraic style. The language is described in terms of abstract syntax only. This approach is argued to be correct in language design. The language designed, BMASF, is simpler than ASF because it has no parameterization mechanism. The method of the design was the objective rather than the development of the language. Reasons for the approach are detailed. ESA

N90-24790# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Algebra, Analysis and Geometry.
STABILITY AND ERROR ESTIMATES FOR SINC INTERPOLATION
M. Zwaan Sep. 1989 14 p
(CWI-AM-R8914; ETN-90-96811) Copyright Avail: NTIS HC A03/MF A01

Stability and error estimates for sinc interpolation are considered. This interpolation technique can be used for interpolating a finite or countable number of data. There is a large amount of literature on the subject of error estimates for sinc interpolation. Estimates are derived by means of operator norms and new bounds are obtained for the amplitude error and the time jitter error, which apply for non uniform sampling. ESA

N90-24791# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Algebra, Analysis and Geometry.
SUPERCONGRUENCES
Matthijs J. Coster Oct. 1989 16 p
(CWI-AM-R8918; ETN-90-96813) Copyright Avail: NTIS HC A03/MF A01

Special congruences are discussed. Supercongruences are explained and definitions given necessary to the explanation. An explanation as to how the congruences arise from formal groups is given and some examples are shown. Generalized Apery numbers are shown to satisfy supercongruence. ESA

N90-24792# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Algebra, Analysis and Geometry.
DIFFUSION IN LATTICES WITH ANISOTROPIC SCATTERERS
J. B. T. M. Roerdink, K. E. Shuler, and G. F. Lawler (Duke Univ., Durham, NC.) Nov. 1989 25 p Sponsord by Alfred P. Sloan Research Fellowship and US Army Research Office
(Grants NATO-0646/85; NSF DMS-89-01805)
(CWI-AM-R8921; ETN-90-96814) Copyright Avail: NTIS HC A03/MF A01

Diffusion in lattices with periodic and random arrangements of anisotropic scatterers is studied. Using both analytical techniques based upon previous work on asymptotic properties of multistate random walks and computer calculation, it is shown that the diffusion constant for the random arrangement of scatterers is bounded above and below at an arbitrary density rho by the diffusion constant for an appropriately chosen periodic arrangement of scatterers at the same density. The accuracy of the low density expansion for the diffusion constant up to second order in the density for a lattice with randomly distributed anisotropic scatterers is investigated. Comparison of the analytical results with numerical calculations shows that the accuracy of the density expansion depends crucially on the degree of anisotropy of the scatterers. A monotonicity law for the diffusion constant with respect to variation of the transition rates is discussed, in analogy with the Rayleigh monotonicity law for the effective resistance of electric networks. As an immediate corollary the diffusion constant, averaged over all realizations of the random arrangement of anisotropic scatterers at density rho, is shown to be a monotone function of the density. ESA

N90-24793# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Algebra, Analysis and Geometry.
ASYMPTOTIC EXPANSIONS OF AN INTEGRAL CONTAINING A PHASE FUNCTION WITH THREE SADDLE POINTS
A. B. Olde Daalhuis Dec. 1989 10 p
(CWI-AM-R8922; ETN-90-96815) Copyright Avail: NTIS HC A02/MF A01

New asymptotic expansions are given for a special function of two complex variables. The approach is based on an integral representation. The phase function of the integral has three saddle points, and for certain combinations of the variables two of these saddle points coalesce. ESA

N90-24794# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
CONSTRUCT ANALYSIS IN KNOWLEDGE GRAPHS
Mark Willems Oct. 1989 19 p
(MEMO-815; ISSN-0169-2690; ETN-90-96820) Avail: NTIS HC A03/MF A01

Some problems in the theory of constructs are discussed. In the theory only acyclic directed graphs can be handled. Some algorithms for finding maximal constructs that can handle circuits are introduced. The notion of construct is shown to be necessarily unmanageable. Acyclic connected constructs, which can be used as a definition of coherent structure, are defined. Their number is shown to be polynomial in the number of points of any digraph. An algorithm for finding these acyclic connected constructs is given. ESA

N90-24795# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
ON COMPUTATIONAL ASPECTS OF SIMPLICIAL SPLINES
M. Neamtu and C. R. Traas Nov. 1989 23 p
(MEMO-818; ISSN-0169-2960; ETN-90-96823) Avail: NTIS HC A03/MF A01

Some new results on multivariate simplex B-splines and their practical application are presented. New recurrence relations are derived. Remarks on boundary conditions are given and an example of an application of bivariate quadratic simplex splines is presented. The application concerns the approximation of a surface which is constrained by a differential equation. ESA

N90-24796# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
MINIMUM LOSS SCHEDULING
W. M. Nawijn, W. Kern, and S. Baas Nov. 1989 19 p
(MEMO-821; ISSN-0169-2690; ETN-90-96826) Avail: NTIS HC A03/MF A01

A single machine with a buffer of capacity one for waiting jobs is considered. Given the arrival epochs, the weights and the processing times of n consecutive future jobs, a maximum weight subset of jobs is to be found that is schedulable without violating the buffer's capacity constraint. A polynomial algorithm for the unweighted loss-delay problem is presented. For the weighted one machine case, shown to be NP-hard, a dynamic programming formulation is given. ESA

N90-24797# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
BIVARIATE SIMPLICIAL SPLINES IN FINITE ELEMENT COMPUTATIONS
C. R. Traas Nov. 1989 24 p
(MEMO-823; ISSN-0169-2690; ETN-90-96828) Avail: NTIS HC A03/MF A01

Bivariate quadratic simplicial splines for approximating surfaces which are constrained are applied to satisfy an elliptic partial differential equation. Attention is given to a number of processes which are fundamental in such applications: pulling apart, satisfying given boundary conditions and computing inner products. Results from a test problem are presented. ESA

N90-24798# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
SECOND ORDER ASYMPTOTICS IN LEVEL CROSSING PROBLEMS FOR DIFFERENCES OF RENEWAL PROCESSES
D. P. Kroese and W. C. M. Kallenberg Nov. 1989 30 p
(MEMO-824; ISSN-0169-2690; ETN-90-96829) Avail: NTIS HC A03/MF A01

Level crossing for the difference of independent renewal processes is considered. Second order expansions for the distribution function of the crossing time of level n are found, as n tends towards infinity. As a byproduct several other results on the difference process are found. The expected minimum of the difference process appears to play an important role in the analysis. This makes this problem essentially harder than the level crossing for the sum process which was studied earlier. ESA

N90-24799# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
ON A CLASS OF GENERALIZED ORTHOGONAL POLYNOMIALS WITH REAL ZEROS
E. A. vanDoorn Nov. 1989 19 p
(MEMO-826; ISSN-0169-2690; ETN-90-96831) Avail: NTIS HC A03/MF A01

A class of polynomial sequences defined by a three-term recurrence relation, the parameters of which satisfy a chain-sequence condition, is studied. Alternative characterizations of this class, showing in particular that it is a subclass of the class of polynomial sequences studied by Sato (1988) are given. Hence, the zeros of these polynomials are shown to be real and to enjoy a separation property. Alternative proofs of these findings are presented and some related results are established. ESA

N90-24800# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
ON THE INDEPENDENCE OF B-SPLINES ON UNORDERED KNOT SETS
Ruud vanDamme Nov. 1989 19 p
(MEMO-827; ISSN-0169-2690; ETN-90-96832) Avail: NTIS HC A03/MF A01

An introduction to B-splines is given. To what extent B-splines on any unordered knot configuration are able to approximate functions in comparison with the splines on the same regular knot set, is investigated. A simple necessary and sufficient condition on the knot sequence to guarantee equivalence is proved. ESA

N90-24801# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
MULTI-GRID AND B(OX)-SPLINES
Ruud vanDamme Nov. 1989 19 p Presented at NATO ASI on Computation of Curves and Surfaces, Tenerife, Spain, Jul. 1989
(MEMO-828; ISSN-0169-2690; ETN-90-96833) Avail: NTIS HC A03/MF A01

The multi-grid algorithm is investigated for approximation problems, Laplace equations and biharmonic equations, when B-splines and box-splines (in one and two dimensions respectively) are being used. It turns out for approximation problems the algorithm cannot compete with standard iterative procedures. The multi-grid algorithm works fine for elliptic boundary value problems for all B-splines and a large class of box-splines. In particular it is not suited for box-splines on a four direction mesh. Theoretical predictions on convergence are made and compared with experiment: there is a good agreement between the two. ESA

N90-24802# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
FUNDAMENTAL LIMITATIONS OF QUALITATIVE SIMULATION
Andrej Makarovic and Nicolaas J. I. Mars 3 Nov. 1989 49 p
(MEMO-INF-89-56; UT-KBS-89-05; ISBN-90-365-0315-9; ISSN-0923-1714; ETN-90-96846) Avail: NTIS HC A03/MF A01

Unfavorable experience with current implementations of qualitative simulation, even in simple cases, raises the question whether further developments can ever lead to a satisfactory performance. The limitations of qualitative simulation are shown to be a direct consequence of each of three major design decisions: the choice of the quantification of the derivatives (too coarse), the use of an ordinal scale, and the choice of the prediction step size (too small relative to the quantification of the state space). For each of these design decisions separately, an optimistic estimate of the performance is made in terms of: the relative accuracy of the predictions, what kind of information could be obtained, and the average number of predicted behaviors to be expected for a wide class of representative differential equations. To attain a significant improvement, all three design decisions must be revised simultaneously. These necessary revisions amount to a new design. ESA

N90-24803# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
ACHROMATIC NUMBER IS NP-COMPLETE FOR COGRAPHS AND INTERVAL GRAPHS
Hans L. Bodlaender Aug. 1988 7 p
(RUU-CS-88-25; ETN-90-96848) Avail: NTIS HC A02/MF A01

The achromatic number problem is shown to be NP-complete when restricted to connected graphs which are simultaneously a cograph and an interval graph. A proof is presented. Definitions are provided for the different types of graphs investigated. Reference is made to the correct colorings achromatic number problem. Parallels are drawn between it and the graph problems. An easy transformation, used to apply the results of the proofs for graphs that are cographs and interval graphs that are not connected, to cases where they are connected, is described. ESA

N90-24804# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
INTERSECTING LINE SEGMENTS, RAY SHOOTING, AND OTHER APPLICATIONS OF GEOMETRIC PARTITIONING TECHNIQUES
Leonidas J. Guibas, Mark H. Overmars, and Micha Sharir (New York Univ., New York.) Aug. 1988 12 p
(RUU-CS-88-26; ETN-90-96849) Avail: NTIS HC A03/MF A01

A variety of applications of techniques based on partition trees are presented. The techniques were originally developed for range searching problems. Results obtained by enhancing and extending these techniques are presented. Applications concern implicit point location, hidden surface removal in three dimensions, polygon placement queries, and problems involving overlapping planar maps. Several algorithms involving the analysis of the connectivity and other useful properties of arrangements of line segments are presented. ESA

N90-24805# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
IMPROVED SELF-REDUCTION ALGORITHMS FOR GRAPHS WITH BOUNDED TREE WIDTH
Hans L. Bodlaender Sep. 1988 18 p
(RUU-CS-88-29; ETN-90-96851) Avail: NTIS HC A03/MF A01

Algorithms proposed by Robertson and Seymour are critically evaluated. The results are shown to be non-constructive in two ways. The algorithm only decides on membership, but does not construct a solution e.g., a linear ordering, decomposition or embedding. No method is given to find the algorithms. Ways of avoiding both non-constructive elements are presented. The techniques proposed by Fellows and Lanston are based on self-reduction. Two techniques that help the reduce the running time of self-reduction algorithms are proposed. ESA

N90-24806# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
FINDING SQUARES AND RECTANGLES IN SETS OF POINTS
Marc J. vanKreveld and Mark T. Deberg Apr. 1989 20 p
Sponsored by Netherlands Organization for Scientific Research
(RUU-CS-89-10; ETN-90-96865) Avail: NTIS HC A03/MF A01

The following problem is studied: given a set S of n points in the plane, does it contain a subset of four points that form the vertices of a square or rectangle. Both the axis-parallel case and the arbitrarily oriented case are studied. Extensions to the d-dimensional case are outlined. Algorithms are developed for both axis-parallel and arbitrarily oriented cases. Combinatorial results on the maximal number of squares and rectangles any point set can contain are given. ESA

N90-24807# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
RAY SHOOTING, IMPLICIT POINT LOCATION, AND RELATED QUERIES IN ARRANGEMENTS OF SEGMENTS
Leonidas J. Guibas, Mark H. Overmars, and Micha Sharir (New York Univ., New York.) May 1989 23 p Sponsored by Digital Equipment Corp.; IBM; and National Council for Research and Development, Tel-Aviv, Israel
(Contract N00014-82-K-0381; NSF DCR-83-20085)
(RUU-CS-89-11; ETN-90-96866) Avail: NTIS HC A03/MF A01

Techniques for half-plane range searching are extended to obtain algorithms for answering several types of queries on planar arrangements of segments and certain related structures. It is shown that given n segments in a plane, they can be preprocessed in O(n log n) randomized expected time and O(n) space, so that given a query ray emanating from an arbitrary point in an arbitrary direction, we can determine the first segment (if any) hit by the ray. Other results involved implicit point location in an arrangement of (possibly intersecting) triangles, polygon placement queries, and certain restricted types of ray shooting and hidden surface removal for three dimensional polyhedral scenes. ESA

N90-24808# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
COUNTING AND REPORTING INTERSECTIONS IN ARRANGEMENTS OF LINE SEGMENTS
Leonidas J. Guibas, Mark H. Overmars, and Micha Sharir (New York Univ., New York.) May 1989 8 p Sponsored by Digital Equipment Corp.; IBM; and National Council for Research and Development, Tel-Aviv, Israel
(Contract N00014-82-K-0381; NSF DCR-89-20085)
(RUU-CS-89-12; ETN-90-96867) Avail: NTIS HC A02/MF A01

Algorithms for counting and reporting all intersections in an arrangement of n line segments in the plane are discussed. A randomized algorithm for finding all k intersections in such an arrangement is derived. A variant of the algorithm counts the number of intersections in randomized expected time. The techniques are based on recursive decomposition of the problem into subproblems of smaller size using plane partition methods that involve random sampling of the given segments. ESA

N90-24809# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
THE SYSTEMATIC CONSTRUCTION OF A ONE-COMBINATOR BASIS
Jeroen Fokker May 1989 7 p
(RUU-CS-89-14; ETN-90-96869) Avail: NTIS HC A02/MF A01

A single closed lambda-expression that generates all lambda expressions is constructed. The derivation is carried out in a systematic way. A comparison to other bases in the literature is presented. To evaluate the simplicity of the various solutions, the size of an expression is defined by the number of abstractions and applications in it. The systematically derived solutions introduced are determined to be the smallest in size and are comparable to Rosser's in normalization speed. ESA

N90-24810# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
CONCATENABLE STRUCTURES FOR DECOMPOSABLE PROBLEMS
Mark J. vanKreveld and Mark H. Overmars Aug. 1989 21 p
(Contract EC-3075)
(RUU-CS-89-16; ETN-90-96871) Avail: NTIS HC A03/MF A01

Methods for obtaining a modified data structure that allows for splits and concatenations with respect to an ordering of the objects it contains are discussed. A general technique which works for all data structures for decomposable searching problems and order decomposable set problems is presented. The results imply a new method for adding range restrictions to data structures. Different applications of the technique are presented. Amongst the applications is a version of an interval tree that allows for splitting and concatenating on the length of the intervals. A version of the d-dimensional k-tree that allows for splitting and concatenating on all coordinates, and a data structure on points in the plane that allows for reporting the convex hull of the points in a given query rectangle are two other applications of the technique. ESA

N90-24811# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
STORING LINE SEGMENTS IN PARTITION TREES
Mark H. Overmars, Haiju Schipper, and Micha Sharir (New York Univ., New York.) Aug. 1989 22 p Sponsored by DEC; IBM Corp.; U.S.-Israeli Binational Science Foundation; Israeli National Council for Research and Development; and Israeli Academy of Sciences
(Contracts EC-3075; N00014-87-K-0129; NSF DCR-83-20085; NSF DCR-89-01484)
(RUU-CS-89-17; ETN-90-96872) Avail: NTIS HC A03/MF A01

Two variants of planar partition trees are designed. These are called segment partition trees and interval partition trees. They can be used for storing arbitrarily oriented line segments in the plane in an efficient way. The raw structures use O(n log n) and O(n) storage respectively and their construction time is O(n log n). These structures are augmented by certain auxiliary structures which may increase the storage and preprocessing time by a

polylogarithmic factor. The use of these structures in solving line segment intersection queries, triangle stabbing queries and ray shooting queries is described. ESA

N90-24812# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
RANKING INTERVALS UNDER VISIBILITY CONSTRAINTS
Herbert Edelsbrunner, Mark H. Overmars, and Emo Welzl (Freie Univ., Berlin, Germany, F.R.) Aug. 1989 17 p
(Grants NSF CCR-87-14565; DFG-We-1265/1-1)
(RUU-CS-89-18; ETN-90-96873) Avail: NTIS HC A03/MF A01

A ranking system is developed for a set S of n closed intervals on the x-axis. The ranking assigns a distinct rank to each interval s. It is shown that a ranking can be found in time O(n log n) such that each interval sees at most three other intervals. A ranking that minimizes the average number of endpoints visible from an interval is computed in time O(n to the 5/2 power). Application of the results to interval intersection problems is discussed. ESA

N90-24813# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
TRADE-OFFS IN NON-REVERSING DIAMETER
Hans L. Bodlaender, Gerard Tel, and Nicola Santoro (Carleton Univ., Ottawa, Ontario) Oct. 1989 25 p Sponsored in part by Canadian National Science and Engineering Research Council
(Contract EC-3075)
(RUU-CS-89-22; ETN-90-96874) Avail: NTIS HC A03/MF A01

The notion of diameter in a tree T with a number of extra edges (the bridges) added is discussed. The diameter is obtained by admitting only path p with the property that for every bridge b in paths p, no edge that is on the unique path (in T) between the endpoints of b is also in p or on the unique path between the two endpoints of any other bridge in p. The tradeoff between the number of added bridges and the resulting diameter is investigated. Upper and lower bounds of the same order are obtained for all diameters of constant size. Applications of the technique are described. ESA

N90-24814# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
AN INPUT-SIZE/OUTPUT-SIZE TRADE-OFF IN THE TIME-COMPLEXITY OF RECTILINEAR HIDDEN SURFACE REMOVAL
Michael T. Goodrich, Mikhail J. Atallah (Purdue Univ., West Lafayette, IN.), and Mark H. Overmars Nov. 1989 31 p
(Contracts EC-3075; N00014-84-K-0502; N00014-86-K-0689; NSF CCR-88-10568; NSF CCR-89-08092; NSF DCR-84-51393; R01-LM05118)
(RUU-CS-89-24; ETN-90-96876) Avail: NTIS HC A03/MF A01

An algorithm for the hidden-surface elimination problem for rectangles is presented. This problem is also known as the window rendering problem. The time complexity of the algorithm is dependent on both the number of input rectangles n and on the size of the output k. This is significant, for k is theta(n squared) in the worst case, but for most problem instances k is much smaller than this (k can be O(1) in some cases. ESA

N90-24815# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
FINDING COMPLETE BIPARTITE SUBGRAPHS IN BIPARTITE GRAPHS
Mark deBerg, Mark H. Overmars, and Marc J. vanKreveld Dec. 1989 9 p Sponsored in part by Netherlands Organization for Scientific Research
(Contract EC-3075)
(RUU-CS-89-30; ETN-90-96878) Avail: NTIS HC A02/MF A01

The problem of determining whether a bipartite graph G contains a K sub (l,m) as a subgraph is investigated. A K sub (l,m) is a complete bipartite graph with l nodes in one node set and m nodes in the other node set. The problem is solved using a transformation to a geometrical setting. For variables l and m this problem is NP-complete. So l and m are considered to be constants. The key to the problem lies in the fact that a set of points cannot contain too many subgrids of size l by l without containing a subgrid of size l by m. ESA

N90-24816# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
TRANSLATING POLYGONS WITH APPLICATIONS TO HIDDEN SURFACE REMOVAL
Mark deBerg Dec. 1989 19 p Sponsored in part by Netherlands Organization for Scientific Research
(Contract EC-3075)
(RUU-CS-89-31; ETN-90-96879) Avail: NTIS HC A03/MF A01

A translation ordering for a set of polygons S in the plane is discussed. The ordering is carried out such that if the polygons are moved one by one to infinity in direction d, no collisions occur between the polygons. After O(n log n) preprocessing using O(n) space, it is possible to determine, for any given d, in O(log n) time whether such an ordering exists and, if so, compute an ordering in O(n) time. The technique can be used to generate displaying orderings for polyhedral terrains. One of the advantages of the technique is that it can easily be adapted to handle perspective views within the same time and space bounds. ESA

N90-24817# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
AN IMPROVED TECHNIQUE FOR OUTPUT-SENSITIVE HIDDEN SURFACE REMOVAL
Micha Sharir (New York Univ., New York.) and Mark H. Overmars Dec. 1989 21 p Sponsored by US-Israeli Binational Science Foundation; the Israeli National Council for Research and Development; and Israeli Academy of Sciences
(Contracts EC-3075; N00014-87-K-0129; NSF CCR-89-01484)
(RUU-CS-89-32; ETN-90-96880) Avail: NTIS HC A03/MF A01

An output-sensitive algorithm for hidden surface removal in a collection of n triangles is derived. The triangles are viewed from a point z such that they can be ordered in an acyclic fashion according to their nearness to z. If k is the combinatorial complexity of the output visibility map, a sophisticated randomized algorithm is developed. The method is based on a technique for tracing visible contours using ray shooting. ESA

N90-24818# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Algorithms and Architecture.
COMPUTING BOOLEAN FUNCTIONS ON ANONYMOUS NETWORKS
Evangelos Kranakis and Danny Krizanc (Rochester Univ., NY.) Sep. 1989 19 p Submitted for publication
(CWI-CS-R8935; ETN-90-96806) Copyright Avail: NTIS HC A03/MF A01

The bit complexity of computing Boolean functions on anonymous networks is studied. For arbitrary unlabeled networks, a general algorithm of polynomial bit complexity for computing any Boolean function computable in this network is given. The class of distance regular unlabeled networks is considered, any symmetric functions in such networks are shown to be computable efficiently in a given number of bits. An oriented hypercube is studied. The bits required for computation of symmetric functions is given. ESA

N90-24819# Technische Univ., Eindhoven (Netherlands).
STRUCTURE OF LINEAR-QUADRATIC CONTROL Ph.D. Thesis
Antonius Henricus Wi Geerts 1989 173 p
(ETN-90-96894) Avail: NTIS HC A08/MF A01

The future of Linear Quadratic Control Problems (LQCPs) is discussed with respect to several unsolved questions. A mathematical description of LQCPs and the notion of Dissipation Inequality (DI), regularity and singularity and rank minimizing solutions of the DI are introduced. The influence of the generalized dual structure algorithm is used throughout the study and the algorithm is outlined. Nonnegative definite LQCPs with linear endpoint constraints and the limiting behavior of perturbed endpoint constrained LQCPs are studied. Unsolved questions are described. ESA

N90-24820# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.
EXPLICIT FIXED POINTS FOR INTERPRETABILITY LOGIC
Dick deJongh and Albert Visser (Utrecht State Univ., Netherlands) Mar. 1989 12 p
(ITLI-ML-89-01; ETN-90-96915) Avail: NTIS HC A03/MF A01

Basic theorems of provability logic are addressed. The problem of uniqueness and explicit definability of fixed points for interpretability logic is considered. Uniqueness is shown as an immediate corollary of a theorem of Smorynski, so the study is devoted to proving explicit definability. ESA

N90-24821# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.
EXTENDING THE LAMBDA CALCULUS WITH SURJECTIVE PAIRING IS CONSERVATIVE
Roel deVrijer Mar. 1989 15 p Presented at the Symposium on Logic in Computer Science, Asilomar, CA, 5-8 Jun. 1989 Revised
(ITLI-ML-89-02; ETN-90-96916) Avail: NTIS HC A03/MF A01

The equational theory lambda(pi) of lambda-calculus extended with constants pi, pi(sub 0), pi(sub 1), and axioms for surjective pairing pi sub 0 (pi XY) = X, pi sub 1 (piXY) = Y, pi(pi sub 0(X)) (pi sub 1 (X))=X, is considered. The reduction system obtained by reading the equations as reductions (from left to right) is not Church-Rosser. Despite this failure, a syntactic consistency proof of lambda(pi) is obtained. Lambda(pi) is shown to be conservative extension of the pure lambda-calculus. ESA

N90-24822# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.
ROSSER ORDERINGS AND FREE VARIABLES
Dick deJongh and Franco Montagna (Siena Univ., Italy) Jul. 1989 13 p
(ITLI-ML-89-03; ETN-90-96917) Avail: NTIS HC A03/MF A01

The arithmetical completness theorem of Solovay for the modal system L and its extension to arithmetical completeness for a system R, which includes witness comparison symbols and thereby to a certain extent takes Rosser sentences into account, is addressed. In the use of free variables in extending arithmetical interpretations it is shown that R gets be to arithmetically complete. ESA

N90-24823# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.
SIGMA-COMPLETENESS AND BOUNDED ARITHMETIC
Rineke Verbrugge Oct. 1989 39 p
(ITLI-ML-89-05; ETN-90-96918) Avail: NTIS HC A03/MF A01

Results obtained in a quest to prove or disprove the extension of Solovay's completeness theorem to bounded arithmetic are given. In the standard proof of both Solovay's and Rosser's theorems the provability of sigma-completeness is essential. Under the complexity hypothesis NP not equal to co-NP, it is shown that sigma-completeness is not provable in the system of bounded arithmetic investigated. Rosser's and a restricted version of Solovay's completeness theorems are proved using a weak reflection principle. A proof of this principle, by Svejdar is presented. ESA

N90-24824# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.
THE AXIOMATIZATION OF RANDOMNESS
Michiel vanLambalgen Oct. 1989 29 p Submitted for publication Sponsored by Netherlands Organization for Scientific Research
(ITLI-ML-89-06; ETN-90-96919) Avail: NTIS HC A03/MF A01

A faithful axiomatization of von Mises' notion of a random sequence, using an abstract independence relation, is presented. A byproduct is a quantifier elimination theorem for Friedman's almost all quantifier in terms of this independence relation. ESA

N90-24825# Groningen Rijksuniv. (Netherlands).
FORMAL GROUPS AND DIFFERENTIAL EQUATIONS Ph.D. Thesis
Bert vanderMarel 1989 114 p Sponsored by Netherlands Organization for Scientific Research
(ETN-90-96924) Avail: NTIS HC A06/MF A01

The possibility of finding the matrix of an algebraic curve in a sufficient explicit example and establishing the existence of p-adic monodromy are addressed. An irreductible, nonsingular, projective algebraic curve, defined by an equation with integer coefficients is considered. A formal group is shown to be potentially multiplicative. The R-infinity module of the image of the invariant differentials on this group in a suitable cohomology space is an F-crystal, which is canonically dual to (U, inverted triangle, F). Associated with U there is a continuous p-adic representation of an algebraic fundamental group which is called p-adic monodromy. ESA

N90-24826# Leiden Univ. (Netherlands). Dept. of Mathematics and Computer Science.
ON THE USE OF STABILITY REGIONS IN THE NUMERICAL ANALYSIS OF STABILITY VALUE PROBLEMS
H. W. J. Lenferink and M. N. Spijker Sep. 1989 23 p Sponsored by Netherlands Organization for Scientific Research
(TW-89-07; ETN-90-96929) Avail: NTIS HC A03/MF A01

The stability analysis of one-step methods in the numerical solution of initial value problems is discussed. The cases of linear, ordinary and partial differential equations are taken into account. Restrictions on the stepsize are derived which guarantee that the rate of error growth in these methods will be of moderate size. The errors in the one-step methods are measured in arbitrary norms (not necessarily generated by an inner product). The theory is illustrated in the numerical solution of the heat equation and some other differential equations where the error growth is measured in the maximum norm. ESA

N90-24827# Leiden Univ. (Netherlands). Dept. of Mathematics and Computer Science.
ON A GENERALIZATION OF THE RESOLVENT CONDITION IN THE KREISS MATRIX THEOREM
H. W. J. Lenferink and M. N. Spijker Sep. 1989 14 p Sponsored by Netherlands Organization for Scientific Research
(TW-89-08; ETN-90-95930) Avail: NTIS HC A03/MF A01

A condition on the resolvent of s by s matrices is discussed. In one of the equivalent assertions of the Kreiss matrix theorem, the spectral norm of the resolvent of A at zeta must satisfy an inequality for all zeta lying outside the unit disk in C. A generalization based on the fact that domains different from the unit disk and more general norms are allowed is considered. Under this generalized resolvent condition an upper bound is derived for norms of the nth powers of s by s matrices B, where B depends on A. This generalizes an upper bound occurring in the Kreiss theorem where B is equal to A. Like the classical Kreiss theorem, the upper bound derived in this paper can be used in the stability analysis of numerical methods for solving differential equations. ESA

N90-24828# Nebraska Univ., Lincoln.
APPLICATIONS OF CONE THEORY TO BOUNDARY VALUE PROBLEMS M.S. Thesis
Gerald Diaz Nov. 1989 142 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A220939; AFIT/CI/CIA-90-003D) Avail: NTIS HC A07/MF A01 CSCL 12/3

The existence and comparison of eigenvalues for the eigenvalue problem (-1) exp(n-1)Lu = lambda P(t)u, Tu = 0, where Tu = 0 are appropriate boundary conditions at points in the interval (a,b) are examined. Here u(t) is an m-column vector function, P(t) is a continuous m x m matrix function on (a,b) and Lu = u(exp n) + p1(t)u(exp(n-1) +...+ Pn(t). Assume that the corresponding scalar equation Ly = 0 is right disfocal on (a,b). Existence and comparison results are gotten by using several abstract theorems from cone theory in a Banach space. We first consider the boundary value

problem u(exp(n) + r(t)u = 0, u(exp i) (a) = 0, i = 0,1,...,k-1 and u(exp(i sub j)(b) = 0, j = 1,2,...,n-k. Using comparison theorems for Green's functions due to Peterson and Ridenhour, the cone theory is applied to get the existence and uniqueness of an eigenvector in a cone. Further, comparison results are given between the smallest positive eigenvalues of different eigenvalue problems. GRA

N90-24829# California Univ., Santa Barbara. Dept. of Physics.
TIME-DEPENDENT DENSITY-FUNCTIONAL THEORY Technical Report, 1 Jan. - 31 Dec. 1990
E. K. U. Gross and W. Kohn May 1990 40 p Submitted for publication Sponsored in part by Deutsche Forschungsgemeinschaft, Fed. Republic of Germany
(Contract N00014-89-J-1530; NSF DMR-87-03434)
(AD-A220993; TR-26) Avail: NTIS HC A03/MF A01 CSCL 12/1

Density functional theory for stationary states or ensembles is a formulation of many-body theory in terms of the particle density, rho(r). It is now a mature subject which has had many successful applications. Time-dependent density functional theory as a complete formalism is of more recent origin. A detailed description of time-dependent density-functional formalism is presented with emphasis on evolving applications. GRA

N90-24830# Southern Methodist Univ., Dallas, TX. Dept. of Statistical Science.
A GENERAL METHOD FOR APPROXIMATING IMPROPER INTEGRALS
H. L. Gray and Suojin Wang 17 Apr. 1990 29 p Submitted for publication
(Contract F19628-88-K-0042)
(AD-A221153; GL-TR-90-0095) Avail: NTIS HC A03/MF A01 CSCL 12/3

In this paper the authors introduce a new transformation, which is in fact the limit of the Levin and Sidi D-transformation when applied to a function evaluated at equally spaced points. The Levin-Sidi generalization has been clearly shown to be a powerful tool for evaluating improper integrals when the integrand is given at a sequence of points. GRA

N90-24831# Rutgers - The State Univ., New Brunswick, NJ. Center for the Mathematical Sciences.
A RUTCOR PROJECT IN DISCRETE APPLIED MATHEMATICS Final Technical Report, 1 Nov. 1988 - 31 Oct. 1989
Peter L. Hammer and Fred S. Roberts 20 Feb. 1990 74 p
(Grant AF-AFOSR-0066-89; AF Proj. 2304)
(AD-A221191; AFOSR-90-0390TR) Avail: NTIS HC A04/MF A01 CSCL 12/1

This project has been concerned with research in discrete mathematics and its applications. The work has involved theoretical developments, the development of new algorithms, and the application of discrete methods to practical problems. There have been five major areas of emphasis. The first, graph theory and its applications, has been concerned with graph coloring and stability and their applications, with special classes of graphs (such as perfect graphs, threshold graphs, competition graphs), and with the use of graphs to solve discrete optimization problems. The second area has involved discrete optimization, and has emphasized location problems, preprocessing and decomposition methods for solving such problems and applications of combinatorial optimization to nonlinear problems (global optimization). The third area of emphasis has been on combinatorial structures and their applications. The fourth area has been the development of efficient algorithms for discrete problems. The fifth area of emphasis has been applications of discrete mathematics to decision making. GRA

N90-24832# Southern Methodist Univ., Dallas, TX. Dept. of Statistical Science.
MORE ABOUT GENERAL SADDLEPOINT APPROXIMATIONS
Suojin Wang 17 Apr. 1990 15 p
(Contract F19628-88-K-0042)
(AD-A221217; GL-TR-90-0094) Avail: NTIS HC A03/MF A01 CSCL 12/3

In Easton and Ronchetti (1986), a method of generalized saddlepoint approximations is proposed and shown useful, especially in the case of small sample sizes. A possible improvement of the method is suggested to prevent its potential deficiencies and increase its applicability. Easton and Ronchetti's approximation and its modified version are extended to bootstrap applications. These results provide a satisfactory answer to Davison and Hinkley's (1988) open question on the bootstrap distribution in the AR(1) model. Numerical examples show the great accuracy of the modified method even when the original approximation fails dramatically. GRA

N90-24833*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
THE CFL CONDITION FOR SPECTRAL APPROXIMATIONS TO HYPERBOLIC INITIAL-BOUNDARY VALUE PROBLEMS Final Report
David Gottlieb and Eitan Tadmor (Tel-Aviv Univ., Israel) Jun. 1990 28 p Submitted for publication
(Contracts NAS1-18605; N00014-86-K-0754; AF-AFOSR-0093-90; NSF DMS-88-10150)
(NASA-CR-182053; NAS 1.26:182053; ICASE-90-42) Avail: NTIS HC A03/MF A01 CSCL 12A

The stability of spectral approximations to scalar hyperbolic initial-boundary value problems with variable coefficients are studied. Time is discretized by explicit multi-level or Runge-Kutta methods of order less than or equal to 3 (forward Euler time differencing is included), and spatial discretizations are studied by spectral and pseudospectral approximations associated with the general family of Jacobi polynomials. It is proved that these fully explicit spectral approximations are stable provided their time-step, delta t, is restricted by the CFL-like condition, delta t less than Const. N(exp-2), where N equals the spatial number of degrees of freedom. We give two independent proofs of this result, depending on two different choices of approximate L(exp 2)-weighted norms. In both approaches, the proofs hinge on a certain inverse inequality interesting for its own sake. The result confirms the commonly held belief that the above CFL stability restriction, which is extensively used in practical implementations, guarantees the stability (and hence the convergence) of fully-explicit spectral approximations in the nonperiodic case. Author

N90-24834*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
APPROXIMATIONS OF THERMOELASTIC AND VISCOELASTIC CONTROL SYSTEMS Final Report
J. A. Burns, Z. Y. Liu, and R. E. Miller (University of Southern California, Los Angeles.) Jun. 1990 70 p Submitted for publication
(Contracts NAS1-18605; F49620-87-C-0116; N00014-88-K-0721; AF-AFOSR-0001-89; AF-AFOSR-0091-90)
(NASA-CR-182054; NAS 1.26:182054; ICASE-90-43) Avail: NTIS HC A04/MF A01 CSCL 12A

Well-posed models and computational algorithms are developed and analyzed for control of a class of partial differential equations that describe the motions of thermo-viscoelastic structures. An abstract (state space) framework and a general well-posedness result are presented that can be applied to a large class of thermo-elastic and thermo-viscoelastic models. This state space framework is used in the development of a computational scheme to be used in the solution of a linear quadratic regulator (LQR) control problem. A detailed convergence proof is provided for the viscoelastic model and several numerical results are presented to illustrate the theory and to analyze problems for which the theory is incomplete. Author

N90-24835# Technische Univ., Berlin (Germany, F.R.). Fachbereich Mathematik.
HAUSDORFF MEASURE AND BOUNDARY BEHAVIOR OF ANALYTIC FUNCTIONS Ph.D. Thesis [HAUSDORFFMASS UND RANDVERHALTEN ANALYTISCHER FUNKTIONEN]
Steffen Rohde 1989 43 p In GERMAN
(ETN-90-96501) Avail: NTIS HC A03/MF A01

The Hausdorff dimension allows a finer classification of the size of a part of finite vector spaces than with Lebesgue measurement. The Block functions were particularly studied by using the results of Anderson, Pitt, Makarov and Hungerford. An estimation of the integral mean value of smooth functions is given. The classification of the internal functions with infinite entropy is achieved. ESA

N90-24836# Academy of Sciences of the Ukrainian SSR, Kiev. Inst. Teoreticheskoj Fiziki.
EFFECTIVE HAMILTONIANS AND THE THEORY OF INVARIANTS
R. M. Asherova, B. I. Zhilinskij, V. B. Pavlov-Verevkin, and Yu. F. Smirnov 1988 29 p In RUSSIAN; ENGLISH summary
(DE90-611035; ITF-88-70) Avail: NTIS (US Sales Only) HC A03/MF A01

Applications of the classical theory of group invariants to the construction of effective Hamiltonians (EH) for various nuclear, molecular etc., systems are discussed. The EH has the form of a power series of fundamental invariants. The latter ones are expressed in terms of the generators of symmetry group G. The properties of a generating function first introduced by Molien are described. The methods of calculating these functions allow the total number of fundamental invariants, the order of each invariant and their structure for any arbitrary finite group of semisimple Lie group G to be found. Author

N90-24979*# Houston Univ., TX. Dept. of Applied Mathematical Sciences.
SOLVING PROBLEMS BY INTERROGATING SETS OF KNOWLEDGE SYSTEMS: TOWARD A THEORY OF MULTIPLE KNOWLEDGE SYSTEMS Final Report
Andre deKorvin *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 15 p
(For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 12A

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N90-24837 New South Wales Univ., Kensington (Australia).
G EXCHANGEABILITY AND THE CONSTRUCTION OF DISTRIBUTION-FREE STATISTICS Abstract Only Ph.D. Thesis
David M. Byron 1989 2 p
Avail: Issuing Activity

A general framework for producing distribution-free statistics is introduced based on the notion of G exchangeability. This notion has wide applicability in creating and analyzing statistical models under a minimum of assumptions, thus providing a basis for distribution-free inference. If X is equivalent to gX for all g in the set of G, where G is some suitably defined group of 1 to 1 transformation of the sample space, then X is G exchangeable. It is shown that non-trivial regions, with probability no greater than some given alpha, can be constructed for any G exchangeable X. Such regions are constructed by using a G decomposition of X, namely the pair of algebras (D,A sub i). It is shown that if X is G exchangeable, then D is conditionally GD free, D and A sub i are conditionally GD independent, and that A sub i is sufficient. The notion of a basic data transformation is extended such that if X is G exchangeable, then there exists a pair (T,S), where X = TS, which generates (D,A sub i). The properties of G exchangeability are investigated leading to a number of useful results. Given any subgroup G prime of G, where X is G exchangeable, it is shown how to construct two conditionally independent statistics which are also conditionally distribution-free. This is extended to a sequence of subgroups of G. It is shown that the distribution-free components of two G decompositions can be exchanged to generate randomized distribution-free statistics. Transformations that eliminate nuisance parameters and at the same time conserve some form of G exchangeability are introduced. Using these results a number of experimental and structured models are analyzed under some form of G exchangeability, resulting in extensions to existing methods. Finally, three methods are introduced with which one can construct distribution-free statistics for testing subhypotheses in any unstructured linear model. Author

N90-24838# Institute of Mathematical Statistics, Hayward, CA.
SYMPOSIUM ON APPLIED PROBABILITY Final Report, 1 Jul. 1989 - 28 Feb. 1990
Robert L. Taylor Feb. 1990 45 p Symposium held in Sheffield, England, 16-19 Aug. 1989
(Contract DAAL03-89-G-0039)
(AD-A218760; ARO-26832.1-MA-CF) Avail: NTIS HC A03/MF A01 CSCL 12/3

Included in the sessions of the Symposium in Applied Probability were: probability problems inspired by physics, models in epidemiology, probability in the theory of algorithms, mathematical models in finance, mathematical genetics, point processes, self-similar processes, networks, and branching processes. A volume of selected proceedings, fully referred and edited, will be published. This report consists largely of the program, including preprints, list of participants and other administrative paperwork. GRA

N90-24839# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Algebra, Analysis and Geometry.
A MARKOV CHAIN IDENTITY AND MONOTONICITY OF THE DIFFUSION CONSTANTS FOR A RANDOM WALK IN A HETEROGENEOUS ENVIRONMENT
J. B. T. M. Roerdink Oct. 1989 17 p
(CWI-AM-R8917; ETN-90-96812) Copyright Avail: NTIS HC A03/MF A01

A two dimensional square lattice is considered which is partitioned into a periodic array of rectangular cells, on which a nearest neighbor random walk with symmetric increments is defined whose transition probabilities only depend on the relative position within a cell. On the basis of a determinantal identity proved here, a result for finite Markov chains which shows that the diffusion constants for the random walk are monotonic functions of the individual transition probabilities is obtained. The similarity of this monotonicity property to Rayleigh's monotonicity law for electric networks or, equivalently, reversible random walks, is pointed out. ESA

N90-24840# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
SOME CONVERGENCE RESULTS FOR PROBABILISTIC TABU SEARCH
U. Faigle and W. Kern Nov. 1989 20 p
(MEMO-822; ISSN-0169-2690; ETN-90-96827) Avail: NTIS HC A03/MF A01

The exploration of general fundamental principles underlying local search strategies for combinatorial optimization is addressed. Many of these strategies can be subsumed under the general framework of so called Tabu search which tries to incorporate strategic ideas into purely memoryless local search heuristics such as simulated annealing. Some examples of such long term memory strategies for modifying both the generation and acceptance probabilities are considered, and their impact on convergence results is investigated. It turns out that several Tabu search ideas may be incorporated into the classical simulated annealing approach without affecting the theoretical convergence properties. ESA

N90-24841# Groningen Rijksuniv. (Netherlands).
ON THE STATISTICAL ANALYSIS OF GROWTH Ph.D. Thesis
Klaas Poortema 1989 103 p
(ETN-90-96923) Avail: NTIS HC A06/MF A01

Both longitudinal and cross sectional growth data are considered. Aspects of modeling, testing, estimation and prediction are considered. Four case studies are presented and are elaborated mathematically. Notation, probabilistic and statistic notions, derivatives of matrices and the Kronecker product are explained. An iteration procedure is proposed for obtaining asymptotically efficient estimators. ESA

N90-25070*# Old Dominion Univ., Norfolk, VA. Dept. of Engineering Management.
OPERATIONS AND SUPPORT COST MODELING USING MARKOV CHAINS Abstract Only
Resit Unal *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 153-154 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 09B

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N90-24842# Army Operational Test and Evaluation Agency, Alexandria, VA.
PROCEEDINGS OF THE 28TH ANNUAL US ARMY OPERATIONS RESEARCH SYMPOSIUM (AORS), VOLUME 1
7 Dec. 1989 734 p Symposium held at Fort Lee, VA, 10-12 Oct. 1989
(AD-A219349) Avail: NTIS HC A99/MF A04 CSCL 12/4

This collection is presented of technical papers and speeches presented to the symposium. The theme of this year's symposium was, Maximizing Army Effectiveness. General subject areas were: (1) Readiness, Sustainability and Support to Forces in the Field; (2) Testing, Field Experiments and Training; (3) Command, Control, Communications, Computers, Intelligence on the Battlefield; (4) System Effectiveness and Survivability on the Realistic Battlefield; (5) Recent Advances in OR Methodology, Evaluation Techniques and Other Selected Topics; (6) Force Design Planning, Programming and Modernization; (7) Manpower and Personnel Analyses; (8) Joint Forces and Strategic Operations; (9) Cost Estimating and Analysis; and (10) Military Engineering. The proceedings are printed in two volumes; Volume 1 contains all papers with unlimited distribution, and abstracts of others. GRA

N90-24843# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
ANALYSIS OF A QUEUEING MODEL OF THE ORWELL SLOTTED RING
B. vanArem Oct. 1989 21 p
(MEMO-812; ISSN-0169-2690; ETN-90-96817) Avail: NTIS HC A03/MF A01

A multi-queue system, which is intended to model a local area network with the Orwell slotted ring protocol with one slot is considered. The arrival processes at the stations are independent and identically distributed batch Poisson processes. The destination pattern is symmetric. Two approaches to obtain the exact stationary expected queue length are carried out, the first based on a decomposition result that can be applied if the model is reformulated as a polling model, the second approach based on the identification of an embedded Markov chain. These approaches result in expressions containing some further unknowns that can be estimated efficiently. This yields two light traffic approximations. The approximations are compared to an existing approximation and simulation results. The approximations appear to perform well for the intended application region and significantly improve the existing approximation. The approximations are extended to the multi-slot case. ESA

N90-24844# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
BAYESIAN CHARACTERIZATION AND DETECTION OF RARE BINARY SIGNATURE EVENTS
Richard C. Raup 15 Mar. 1990 41 p
(Contract F19628-90-C-0002)
(AD-A221116; TR-876; ESD-TR-89-295) Avail: NTIS HC A03/MF A01 CSCL 15/3

A method of imposing a binary classification on a target signature is described that transforms a sequence of signatures into a binary-valued time series using the theory of runs. Under the assumption that the time series can be treated as a set of Bernoulli trials, a Bayesian method of estimating a probability density characterizing the outcome of each trial is considered. The density is used to detect signature events which are found to be rare with respect to the classification imposed on the signatures. Finally, tests of homogeneity are used to partition the observed signatures, when necessary, into equivalence classes having the same density characterization. GRA

N90-24845# Lawrence Livermore National Lab., CA.
BRILLIANT PEBBLES
Lowell Wood and Walter Scott Jun. 1989 20 p Presented at the Strategic Defense Initiative Technical Achievements Symposium, Washington, DC, 29-30 Jun. 1989
(Contract W-7405-eng-48)
(DE90-010756; UCRL-101292; CONF-8906320-1) Avail: NTIS HC A03/MF A01

A strategic defense system is sketched which consists of nothing more then a set of identical, highly capable, small spacecraft deployed in low Earth orbit and tasked with interdicting via hypervelocity collision ballistic missiles and their components in flight under human command and control. The member spacecraft of such a defensive constellation may each be equipped with the functional analogs of eyes, mouths, brains and legs capable of detecting and hunting down advanced ballistic missiles over distances of thousands of kilometers without external aid or guidance, yet may have a size and weight comparable to that of a pubescent child. Interestingly enough, these Brilliant Pebbles (highly intelligent but sharply scaled down Smart Rocks) can be implemented with contemporary American technology for a deployed cost of much less than a million dollars each, and less than 10,000 of them appear likely to offer a robust, stand-alone strategic defense capability, including the possibility of adaptive preferential defense. Supporting Government test and evaluation of this concept through realistic but Treaty-compliant in-space exercise is the principal focus of the program for the next two years. Other major national security supporting applications of the Brilliant Pebbles technology, such as Brilliant Eyes, are briefly surveyed. DOE

N90-24290# Centre National d'Etudes Spatiales, Toulouse (France). Space Center.
IN-ORBIT OPERATIONS RESEARCH AND DEVELOPMENT PROGRAM OF THE TOULOUSE SPACE CENTER
J.-J. Runavot *In* ESA, Second European In-Orbit Operations Technology Symposium Dec. 1989 p 51-56 (For primary document see N90-24280 18-12)
Copyright Avail: NTIS HC A19/MF A03; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N90-24846# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
AROUND THREE LEMMAS IN HAMILTONIAN GRAPH THEORY
D. Bauer (Stevens Inst. of Tech., Hoboken, NJ.), H. J. Broersma,

and H. J. Veldman Oct. 1989 14 p
(Contract MDA904-89-H-2008)
(MEMO-816; ISSN-0169-2690; ETN-90-96821) Avail: NTIS HC A03/MF A01

Three recent lemmas leading to results in Hamiltonian graph theory which generalize and unify many previous results are considered. Several applications of the lemmas, especially to one tough graphs, occur in a survey by Bauer, Schmeichel and Veldman. Recent additional applications are surveyed here. In particular, the lemmas are used to obtain an alternative proof of a recent result of Flandrin, Jung and Li. ESA

N90-24847# Argonne National Lab., IL. Mathematics and Computer Science Div.
DIRECT CALCULATION OF NEWTON STEPS WITHOUT ACCUMULATING JACOBIANS
Andreas Griewank 1989 23 p Presented at the Workshop on Large-Scale Numerical Optimization, Ithaca, NY, 19-20 Oct. 1989
(Contract W-31-109-eng-38)
(DE90-009702; CONF-8910400-2) Avail: NTIS HC A03/MF A01

In the computational practice, nonlinear vector-functions whose roots need to be calculated are often specified in form of an evaluation program supplied by the user. This program typically consists of one or more subroutines that compute values of the dependent variables given values of the independent variables. To this end the evaluation program usually generates a large number of intermediate quantities that are local variables and thus ordinarily not visible to the calling routine. By considering the intermediate quantities as additional independent variables one obtains an extended nonlinear system, which should be attacked directly because of the following desirable properties. The extended Jacobian is extremely sparse and can be evaluated at little extra cost simultaneously with the original vector function. The direct computation of the extended Newton-step by Gaussian elimination with suitable pivoting is never more expensive and sometimes significantly cheaper than the calculation of the original Newton-step by forming and factoring the Jacobian. Moreover, it is shown that any method for computing Newton-steps on the original vector function is in terms of complexity equivalent to scheme for solving a linear system in the extended Jacobian. The conditioning of this large sparse matrix reflects not only the stability of the original vector function but also the accuracy of the evaluation algorithm. This allows the design of realistic stopping criteria without user supplied tolerances. DOE

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N90-24848# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
A NONLOCAL FREE ENERGY DENSITY FUNCTIONAL APPROXIMATION FOR THE ELECTRICAL DOUBLE LAYER
Technical Report No. 9, 10 Apr. 1989 - 10 Apr. 1990
L. Mier-y-Teran (Universidad Autonoma Metropolitana de Mexico, Mexico), S. H. Shu, Henry S. White, and H. T. Davis 10 Apr. 1990 33 p Sponsored in part by CONACYT, Mexico; NSF; and Minnesota Supercomputer Inst.
(Contract N00014-87-K-0494)
(AD-A220664) Avail: NTIS HC A03/MF A01 CSCL 20/3

We construct a free energy density functional approximation for the primitive model of the electrical double layer. The hard shape term of the free energy functional is based on a nonlocal generic model functional proposed by Percus. This latter model functional, which is a generalization of the exact solution for the non-uniform hard rod model, requires as input the free energy of a homogeneous hard-sphere mixture. We choose the extension of the Carnahan-Starling equation of state of mixtures. The electrostatic part of the non-uniform fluid ion-ion correlations present in the interface, is approximated by that of an homogeneous bulk electrolyte. Using the mean spherical approximation for a neutral electrolyte, we apply the theory to symmetrical 1:1 and 2:2 salts in the restricted primitive model. We present comparisons of density profiles and diffuse layer potentials with Gouy-Chapman theory and Monte Carlo data. When available, we also compare our results with data from other recent theories of the double layer. For highly charged surfaces, the profiles show the layering of counterions and charge inversion effects, in agreement with Monte Carlo data. GRA

N90-24849# Naval Research Lab., Washington, DC. Beam Physics Branch.
RELATIVISTIC KLYSTRON AMPLIFIERS DRIVEN BY MODULATED INTENSE RELATIVISTIC ELECTRON BEAMS
Interim Report
Y. Y. Lau, M. Friedman, J. Krall, and V. Serlin 11 Apr. 1990 76 p Sponsored in part by Strategic Defense Initiative Organization, Washington, DC and Harry Diamond Labs., Adelphi, MD
(Contract DE-AI05-86ER-13585)
(AD-A221075; NRL-MR-6627) Avail: NTIS HC A05/MF A01 CSCL 20/3

This paper, gives an overview of the novel relativistic klystron amplifiers which are driven by an annular intense relativistic electron beam (500 kV, 10 kA range) which is modulated by an external RF source (1.3 GHz, 100 kW range). Experiments, theory, simulation and simple models are presented to illustrate the unusual properties of such devices, which result from the intense space charge of the beam. Chief among them include electrostatic insulation against vacuum breakdown at high power levels, efficient current modulation, short bunching length, and amplitude and phase stability of the output signal. Many of these unexpected features were revealed in two separate experiments: one with the lower current beam (5 kA, 2 cm beam radius), and the other one with a higher current beam (16 kA, 6.6 cm beam radius). Three gigawatts of RF power at 1.3 GHz were generated with the large diameter beam at an efficiency of 35 percent with 37 dB gain. These experiments will be reviewed, along with a combination of particle simulation results and analytic models which facilitate the interpretation. GRA

N90-24850# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
A WHITE NOISE THEORY OF INFINITE DIMENSIONAL CALCULUS
Takeyuki Hida Oct. 1989 31 p
(Contract F49620-85-C-0144; AF Proj. 2304)
(AD-A221253; TR-275; AFOSR-90-0398TR) Avail: NTIS HC A03/MF A01 CSCL 12/3

What is described here are mostly survey articles, though some state-of-the-art results are added. A new approach is presented to the study of Gaussian random fields. What is presented here is far from a general theory; however it is hoped that this attempt would be the very first step towards the study of Gaussian random fields using variational calculus. Contents are: White noise; Generalized functionals; Rotation group and harmonic analysis; Applications to Physics; Gaussian random fields. GRA

N90-24851# California Univ., Santa Barbara. Dept. of Physics.
TOWARDS A QUANTUM PUMP OF ELECTRIC CHARGES AND CURRENTS
Q. Niu Dec. 1989 14 p
(Contract N00014-84-K-0548; NSF DMR-87-03434)
(AD-A221257) Avail: NTIS HC A03/MF A01 CSCL 20/3

A critical examination is given of the possibility of realizing a quantum pump of electric charges and currents. The physics is based on the theory of quantum adiabatic particle transport initially due to Thouless. Theoretical guide lines are presented on the experimental conditions for observing this phenomenon. It is argued that potentially very accurate quantization of charge transport or electron current can be achieved, once these conditions are

approximately satisfied. An example of experimental set-up is outlined to demonstrate the practical possibilities. Some comments are also made on the scientific significance of such a quantum device. GRA

N90-24365*# Science High School, Newark, NJ.
THE MAGNETIZATION PROCESS: HYSTERESIS
Richard Balsamel *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 105-113 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 20C

N90-24973*# Xavier Univ. of Louisiana, New Orleans. Dept. of Physics/Engineering.
TEMPERATURE DETERMINATION OF SHOCK LAYER USING SPECTROSCOPIC TECHNIQUES
Murty A. Akundi *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 19 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 20C

N90-24990*# New Mexico State Univ., Las Cruces. Dept. of Mechanical Engineering.
THERMODYNAMIC AND FLUID MECHANIC ANALYSIS OF RAPID PRESSURIZATION IN A DEAD-END TUBE Final Report
Ian H. Leslie *In* Texas A&M Univ.; NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 15 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 20A

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N90-24852*# Eagle Engineering, Inc., Hampton, VA.
SUMMARY OF SONIC BOOM RISE TIMES OBSERVED DURING FAA COMMUNITY RESPONSE STUDIES OVER A 6-MONTH PERIOD IN THE OKLAHOMA CITY AREA
Domenic J. Maglieri and Victor E. Sothcott Washington Apr. 1990 123 p
(Contract NAS9-17900)
(NASA-CR-4277; NAS 1.26:4277) Avail: NTIS HC A06/MF A01 CSCL 20A

The sonic boom signature data acquired from about 1225 supersonic flights, over a 6-month period in 1964 in the Oklahoma City area, was enhanced with the addition of data relating to rise times and total signature duration. These later parameters, not available at the time of publication of the original report on the Oklahoma City sonic boom exposures, are listed in tabular form along with overpressure, positive impulse, positive duration, and waveform category. Airplane operating information along with the surface weather observations are also included. Sonic boom rise times include readings to the 1/2, 3/4, and maximum overpressure values. Rise time relative probabilities for various lateral locations from the ground track of 0, 5, and 10 miles are presented along with the variation of rise times with flight altitude. The tabulated signature data, along with corresponding airplane operating conditions and surface and upper level atmospheric information, are also available on electronic files to provide it in the format for more efficient and effective utilization. Author

N90-24853*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FAA/NASA EN ROUTE NOISE SYMPOSIUM
Clemans A. Powell, comp. Washington Apr. 1990 301 p Symposium held in Hampton, VA, 12-13 Sep. 1989
(NASA-CP-3067; L-16763; NAS 1.55:3067) Avail: NTIS HC A14/MF A02 CSCL 20A

Aircraft community noise annoyance is traditionally a concern only in localities near airports. The proposed introduction of large commercial airplanes with advanced turboprop propulsion systems with supersonic propellers has given rise to concerns of noise annoyance in areas previously considered not to be impacted by aircraft noise. A symposium was held to assess the current knowledge of factors important to the impact of en route noise and to aid in the formulation of FAA and NASA programs in the area. Papers were invited on human response to aircraft noise in areas with low ambient noise levels, aircraft noise heard indoors and outdoors, aircraft noise in recreational areas, detection of propeller and jet aircraft noise, and methodological issues relevant to the design of future studies. For individual titles, see N90-24854 through N90-24873.

N90-24854*# MAG Consultants, Inc., San Francisco, CA.
PROPOSED DEFINITION OF THE TERM EN ROUTE IN EN ROUTE AIRCRAFT NOISE
Maurice A. Garbell *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 9-12 (For primary document see N90-24853 18-71)
Avail: NTIS HC A14/MF A02 CSCL 20A

The problem of en route aircraft noise was examined in a formal, dedicated, setting. Whereas the general meaning of the term en route might be intuitively understood, it is suggested that a precise formal definition of the term en route would be opportune from the outset, especially since the scientific and technical investigation of the problem of noise immissions on the ground from aircraft in flight away from the airspace of an airport may conceivably lead to administrative, regulatory, and legal consequences that would mandatorily require a precise definition of the term en route. Five flight segments, with their differing airframe configurations, engine thrusts, and airspeed management, should form the basis for the differential consideration of the noise immissions perceived on the ground underneath or near the defined segments of the flightpath in en route flight, from the end of the initial climb from an airport after takeoff until the final approach to an airport. Author

N90-24855*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PTA EN ROUTE NOISE MEASUREMENTS
William L. Willshire, Jr. and Donald P. Garber (Planning Research Corp., Hampton, VA.) *In its* FAA/NASA En Route Noise Symposium Apr. 1990 p 13-29 (For primary document see N90-24853 18-71)
Avail: NTIS HC A14/MF A02 CSCL 20A

A long-range advanced turboprop en route noise database was obtained with weather, tracking, and onboard measurements. In-flight noise directivity measurements were made. Data repeatability within a test day was excellent. Day-to-day variability existed and is not completely understood and therefore not predicted. Comparison of a two-dimensional ray-tracing propagation model with the ensemble average ground-measured data was good; however, as stated above, the day-to-day data variability was not completely predicted. Future research will include looking at alternative propagation models. Three-dimensional ray tracing, fast field program, and the parabolic equation are possibilities. The effect of turbulence needs to be accessed. Author

N90-24856*# Transportation Systems Center, Cambridge, MA.
EN ROUTE NOISE: NASA PROPFAN TEST AIRCRAFT (CORRECTED DATA - SIMPLIFIED PROCEDURE)
E. J. Rickley *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 31-40 (For primary document see N90-24853 18-71)
(DOT-TSC-FA953-LR4) Avail: NTIS HC A14/MF A02 CSCL 20A

Surface noise measurements were made during a joint National Aeronautics and Space Administration (NASA) and Federal Aviation Administration (FAA) program to study the high-altitude, low-frequency acoustic noise propagation characteristics of the Advanced Turboprop (propfan) Aircraft. The measurements were made on October 26-31, 1987 in Huntsville, Alabama and on April 3-13, 1989 at the White Sands Missile Range (WSMR), New Mexico. To effectively compare flight-to-flight data as received on

the ground, the procedures and practices of Federal Air Regulation (FAR) Part 36 were used as a guide in adjusting the measured ground data at the time of LA(sub MAX) to a set of reference conditions. After the data for each event were processed using slow detector characteristics, the data record at LA(sub MAX) was then identified and the coordinates of the aircraft at the time of emission were calculated, taking into account atmospheric refraction effects. The effects of atmospheric absorption through the test day and reference day atmosphere were also taken into account and the 1/3-octave data were adjusted accordingly.
Author

N90-24857*# Transportation Systems Center, Cambridge, MA.
EN ROUTE NOISE: NASA PROPFAN TEST AIRCRAFT (CALCULATED SOURCE NOISE
E. J. Rickley *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 41-59 (For primary document see N90-24853 18-71)
(DOT-TSC-FA953-LR5) Avail: NTIS HC A14/MF A02 CSCL 20A

The second phase of a joint National Aeronautics and Space Administration (NASA) and Federal Aviation Administration (FAA) program to study the high-altitude, low-frequency acoustic noise propagation characteristics of the Advanced Turboprop (propfan) Aircraft was conducted on April 3-13, 1989 at the White Sands Missile Range (WSMR), New Mexico. The first phase was conducted on October 26-31, 1987 in Huntsville, Alabama. NASA (Lewis) measured the source noise of the test aircraft during both phases while NASA (Langley) measured surface noise only during the second phase. FAA/NASA designed a program to obtain noise level data from the propfan test bed aircraft, both in the near field and at ground level, during simulated en route flights (35,000 and 20,000 feet ASL), and to test low frequency atmospheric absorption algorithms and prediction technology to provide insight into the necessity for regulatory measures. The curves of calculated source noise versus emission angle are based on a second order best-fit curve of the peak envelope of the adjusted ground data. Centerline and sideline derived source noise levels are shown to be in good agreement. A comparison of the Alabama chase plane source data and the calculated source noise at centerline for both the Alabama and New Mexico data shows good agreement for the 35,000 and the 20,000 feet (ASL) overflights. With the availability of the New Mexico in-flight data, further in depth comparisons will be made.
Author

N90-24858*# Hessian Ministry for Economics and Technology, Frankfurt (Germany, F.R.). Noise Abatement Office.
EN ROUTE NOISE OF TURBOPROP AIRCRAFT AND THEIR ACCEPTABILITY: REPORT OF TESTS
Wolf Held *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 61-80 (For primary document see N90-24853 18-71)
Avail: NTIS HC A14/MF A02 CSCL 20A

The development of propfan-powered aircraft has been observed with great interest. It is obvious that during cruising flight, the aircraft powerplant (propellers) cause a noise clearly perceivable on the ground. It is the audible frequency spectrum of the propfan powerplants relative to the high tip speeds that presents the problem. A flight test was conducted on 30 April, 1989 at the Frankfurt Airport. Results of the test flight are present.
B.G.

N90-24859*# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Entwurfsaerodynamik.
EN ROUTE NOISE OF TWO TURBOPROP AIRCRAFT
Werner Dobrzynski *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 81-129 (For primary document see N90-24853 18-71)
(DLR-Mitt-89-18) Avail: NTIS HC A14/MF A02 CSCL 20A

In order to weigh en route noise emissions originating from future propfan powered aircraft, a data base of emission levels from conventional turboprop aircraft is needed. For this reason flyover noise measurements on two twin-engine turboprop aircraft were conducted at flight heights between 17,000 and 21,000 ft. Acoustic data are presented together with propeller operational parameters and environmental meteorological data. Narrowband spectral analyses demonstrate the characteristic features of the measured propeller noise signatures: Noise spectra are dominated by the propeller rotational noise fundamental frequency and pronounced noise beats occur as a consequence of different rotational speeds of the propellers.
Author

N90-24860*# Landesanstalt fuer Umweltschutz, Baden-Wuerttemberg (Germany, F.R.).
NOISE MEASUREMENTS OF TURBOPROP AIRPLANES AT DIFFERENT OVERFLIGHT ELEVATIONS
K. Mueller *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 131-165 In GERMAN (For primary document see N90-24853 18-71)
Avail: NTIS HC A14/MF A02 CSCL 20A

In order to establish criteria for the regulation of propfan aircraft engine noise emissions, measurement tests of overhead flights of a METRO-3 and a FOKKER-50 aircraft were performed. The decibel levels captured by the ground car microphone are tabulated according to the height of the microphone from the ground as the recording vehicle followed the aircraft through the test flight patterns. Microphone heights of 1.5 and 10 meters from the ground are recorded and correlated to the flight altitudes of the aircraft, which ranged from 5182-6401 meters.
Author

N90-24861*# Wyle Labs., Inc., El Segundo, CA.
SOUND PROPAGATION ELEMENTS IN EVALUATION OF EN ROUTE NOISE OF ADVANCED TURBOFAN AIRCRAFT
Louis C. Sutherland and John Wesler (Wyle Labs., Inc., Arlington, VA.) *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 167-174 (For primary document see N90-24853 18-71)
Avail: NTIS HC A14/MF A02 CSCL 20A

Cruise noise from an advanced turboprop aircraft is reviewed on the basis of available wind tunnel data to estimate the aircraft noise signature at the source. Available analytical models are used to evaluate the sound levels at the ground. The analysis allows reasonable estimates to be made of the community noise levels that might be generated during cruise by such aircraft, provides the basis for preliminary comparisons with available data on noise of existing aircraft during climb and helps to identify the dominant elements of the sound propagation models applicable to this situation.
Author

N90-24862*# Forest Service, San Dimas, CA. Technology and Development Center.
PRELIMINARY THOUGHTS ON AN ACOUSTIC METRIC FOR THE WILDERNESS AIRCRAFT OVERFLIGHT STUDY
Robin T. Harrison and Lawrence Hartmann (Forest Service, Missoula, MT.) *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 175-179 (For primary document see N90-24853 18-71)
Avail: NTIS HC A14/MF A02 CSCL 20A

Preliminary thoughts on acoustic metrics are presented which may be appropriate for the measurement of sound caused by aircraft overflights of wilderness areas. The use of parameter d'(measure of an energy flattened signal plus noise to nose relationship in the third octave, corrected for the efficiency of the observer) as a standard is considered.
Author

N90-24863*# Forest Service, San Dimas, CA.
US FOREST SERVICE AND NATIONAL PARK SERVICE WILDERNESS AIRCRAFT OVERFLIGHT STUDY: SOCIOLOGICAL BACKGROUND AND STUDY PLANS
Robin T. Harrison and Lawrence Hartmann (Forest Service, Missoula, MT.) *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 181-193 (For primary document see N90-24853 18-71)
Avail: NTIS HC A14/MF A02 CSCL 20A

The background and sociological aspects of the combined

U.S. Forest Service and National Park Service Wilderness Aircraft Overflight Study (WACOS) are presented. The WACOS broaches a new area of research by combining aspects of outdoor recreation sociology and aircraft noise response studies. The tasks faced create new challenges and require innovative solutions. Background information on the WACOS is presented with special emphasis on sociological considerations. At the time of this writing, no data have yet been collected, so this paper will present background information, related issues, and plans for data collection. Some recent studies indicate that managers of Forest Service wildernesses and National Park Service areas consider aircraft overflights to be a problem to their users in some areas. Additional relevant background research from outdoor recreation sociology is discussed, followed by presentation of the authors' opinions of the most salient sociological issues faced by this study. The goals and desired end products are identified next, followed by a review of the methods anticipated to be used to obtain these results. Finally, a discussion and conclusion section is provided. Author

N90-24864*# Environmental Protection Agency, Washington, DC.
WHEN PROPFANS CRUISE, WILL LDN 65 FLY
Fred Mintz and William Dickerson *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 195-206 (For primary document see N90-24853 18-71)
Avail: NTIS HC A14/MF A02 CSCL 20A

The type and extent of response that may be expected from the persons exposed to the noise of propfans cruising overhead is examined. The cruise mode is of particular interest because it appears that it is in this mode that the propfan airplane noise differs substantially from the noise of present jet-powered airplanes. Early test data on propfan engines suggests that noise levels on the ground under the flight track of commercial propfan transports may approach 65 decibels. To explore the reaction of the exposed population to repeated noise levels of this magnitude, it may be helpful to review some of the pertinent literature on the effects of environmental noise. Author

N90-24865*# MAG Consultants, Inc., San Francisco, CA.
THE EFFECT OF NOISE-ABATEMENT PROFILES ON NOISE IMMISSIONS AND HUMAN ANNOYANCE UNDERNEATH A SUBSEQUENT CLIMBPATH
Maurice A. Garbell *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 207-215 (For primary document see N90-24853 18-71)
Avail: NTIS HC A14/MF A02 CSCL 20A

En route noise emissions on the ground can be affected by the detailed characteristics of intended noise-abatement climb profiles and procedures to an extent of 10 or more nautical miles from the start of the takeoff roll of a large or heavy air-carrier-type aircraft. Suggestions submitted to the noise abatement officials of the airports at Frankfurt, Federal Republic of Germany, and Zurick, Switzerland, and the aircarriers Lufthansa German Airlines and SWISSAIR are explained and discussed. Author

N90-24866*# MAG Consultants, Inc., San Francisco, CA.
AGENDA TOWARD THE DEVELOPMENT OF A RATIONAL NOISE DESCRIPTOR SYSTEM RELEVANT TO HUMAN ANNOYANCE BY EN ROUTE AIRCRAFT NOISE
Maurice A. Garbell *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 217-222 (For primary document see N90-24853 18-71)
Avail: NTIS HC A14/MF A02 CSCL 20A

A rational, internationally consistent, noise descriptor system is needed to express existing and predicted en route aircraft noise levels in terms closely correlated to the annoyance perceived by people and physiologically identifiable in people, to provide guidance for aircraft and powerplant design, flight management, land-use planning, and building codes. Expanding on previous discussions, a new comprehensive statement of the specific questions that must be resolved by needed research, and the nature and quality of proof that must be adduced to justify further steps toward the drafting and adoption of new international en route aircraft-noise standards is sought. The single noise-descriptor system envisioned must be valid for widely varying aircraft-noise frequency spectra, including time-variant components and agreeable and disagreeable discrete tones and combinations of tones. The measures and criteria established by the system must be valid at high and low immission levels, at high and low ambient noise levels, for great and small number of noise events, and outdoors and indoors. Author

N90-24867*# Meyer (Thomas J.), Hamburg (Germany, F.R.).
ADDITIVE EVALUATION CRITERIA FOR AIRCRAFT NOISE
Thomas J. Meyer *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 223-226 (For primary document see N90-24853 18-71)
Avail: NTIS HC A14/MF A02 CSCL 20A

The occurrence of unexpected aircraft noise events will frequently evoke intense complaints about annoyance over such events. It is recognized that the relationship between the volume of complaints and the corresponding maximum noise levels does in fact depend on the circumstances of the complainants and the time of year. The frequency of occurrence of the respective noise events is also a factor. The possible practical value of the addition of the maximal noise level, to the well-known cumulative noise descriptors L(sub eq), L(sub dn), etc. may be considered. One might start by considering the difference between the L(sub eq) and the average maximal noise level of the twenty loudest single noise events on an average day. A somewhat less sharply focused consideration of the maximum noise levels was adopted. In that standard the scope of noise-mitigation measures is defined generally with reference to L(sub eq). If the average maximal noise level L(sub max) of the entire aircraft fleet mix exceeds the L(sub eq) by more than 20 dB(A) and if more than 20 daily aircraft noise events exceed the L(sub eq) than the difference L(sub max)-20 becomes the key criterion for noise-mitigation measures. A statistical correlation of a large number of data from aircraft-noise-monitoring sensors located both directly underneath and laterally disposed to an aircraft flight-path has supplied a basis for the determination of the distribution of the maximal noise levels about the average value, L(sub max), of each type of aircraft. This distribution is given for the takeoff climb and for the landing approach. Author

N90-24868*# Fields (James M.), Silver Spring, MD.
SOCIAL SURVEY FINDINGS ON EN ROUTE NOISE ANNOYANCE ISSUES
James M. Fields *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 227-252 (For primary document see N90-24853 18-71)
Avail: NTIS HC A14/MF A02 CSCL 20A

Most surveys of residents' reactions to aircraft noise were conducted in the vicinity of airports. The findings in those surveys have supported planning and regulatory actions for the airport noise environment. Now, however, aircraft noise planning and regulations are being considered for a new environment, the en route environment. As policy makers search for bases for public policy in these new noise environments, it is appropriate to ask whether the same scientific evidence which supports airport noise policy can also support en route noise policy. Several aspects of that question are considered. An introduction establishes the scope of the present study and examines alternative study methodologies. Next, the selected study methodology is described and important assumptions are listed. The body of the paper then consists of the findings on en route issues. The final section presents findings on relevant research methods and considers priorities for further research. Author

N90-24869*# Bolt, Beranek, and Newman, Inc., Canoga Park, CA.
PREDICTING THE AUDIBILITY AND ANNOYANCE OF UNDUCTED FAN ENGINES
Sanford Fidell, Linda Secrist, and Marie Helweg-Larsen *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 253-267 (For primary document see

N90-24853 18-71)
(Contract F33615-86-C-0530)
Avail: NTIS HC A14/MF A02 CSCL 20A

Predictions of the prevalence of annoyance associated with aircraft noise exposure are heavily influenced by field studies conducted in urban airport neighborhoods. Flyovers heard in such relatively high ambient noise environments are composed in large part of high absolute level, broadband noise. In contrast, noise exposure created en route by aircraft powered by unducted fan engines is expected to be relatively low in level, but to contain prominent low frequency tonal energy. These tones will be readily audible in rural and other low ambient noise environments. The annoyance of noise intrusions of low absolute level has been shown to be closely related to their audibility. Thus, one way to predict the annoyance of en route noise generated by unducted fan engines is to estimate its audibility relative to that of conventionally powered aircraft in different ambient noise environments. This may be accomplished by computing the audibility of spectra produced by an aircraft powered by unducted fan engines and comparing predicted probabilities of annoyance for them with those of conventionally powered transport aircraft.
Author

N90-24870*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EN ROUTE NOISE ANNOYANCE LABORATORY TEST: PRELIMINARY RESULTS
David A. McCurdy *In its* FAA/NASA En Route Noise Symposium Apr. 1990 p 269-28 (For primary document see N90-24853 18-71)
Avail: NTIS HC A14/MF A02 CSCL 20A

Until recently concerns about the impact of aircraft noise on people have centered around the takeoff and landing operations of aircraft in the vicinity of airport terminals. The development of the advanced turboprop (propfan) engine, modifications to air corridors, and the desire to maintain a natural environment in national parks and recreation areas have now focused attention on the impact at ground level of the en route noise produced by aircraft at cruise conditions and altitudes. Compared to terminal area noise, en route noise is characterized by relatively low noise levels, lack of high frequency spectral content, and long durations. Much research has been directed towards understanding and quantifying the annoyance caused by terminal area aircraft noise, but relatively little research has been conducted for en route noise. To address this need, a laboratory experiment was conducted to quantify the annoyance of people on the ground to en route noise generated by aircraft at cruise conditions. The objectives of the experiment are to determine the annoyance prediction ability of noise measurement procedures and corrections when applied to en route noise; to determine differences in annoyance response to en route noise and takeoff/landing noise; and to determine differences in annoyance response to advanced turboprop en route noise and conventional jet en route noise.
Author

N90-24871*# Geneva Univ. (Switzerland). Centre Univ. d'Ecologie Humaine et des Sciences de l'Environnement.
PROBLEMS RELATED TO AIRCRAFT NOISE IN SWITZERLAND
J. Rabinowitz *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 283-287 (For primary document see N90-24853 18-71)
Avail: NTIS HC A14/MF A02 CSCL 20A

Some of the problems related to aircraft noise such as aircraft noise indices, immission standards, land use planning, en route noise and general sensitivity to noise are briefly discussed.
Author

N90-24872*# Norges Tekniske Hoegskole, Trondheim.
AN AIRCRAFT NOISE STUDY IN NORWAY
Truls T. Gjestland, Kare H. Liasjo, and Hans Einar Bohn (Civil Aviation Administration, Oslo, Norway) *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 289-302 (For primary document see N90-24853 18-71)
Avail: NTIS HC A14/MF A02 CSCL 20A

An extensive study of aircraft noise is currently being conducted in Oslo, Norway. The traffic at Oslo Airport Fornebu that includes both national and international flights, totals approximately 350 movements per day: 250 of these are regular scheduled flights with intermediate and large size aircraft, the bulk being DC9 and Boeing 737. The total traffic during the summer of 1989 was expected to resemble the maximum level to which the regular traffic will increase before the new airport can be put into operation. The situation therefore represented a possibility to study the noise impact on the communities around Fornebu. A comprehensive social survey was designed, including questions on both aircraft and road traffic noise. A random sample of 1650 respondents in 15 study areas were contacted for an interview. These areas represent different noise levels and different locations relative to the flight paths. The interviews were conducted in a 2 week period just prior to the transfer of charter traffic from Gardemoen to Fornebu. In the same period the aircraft noise was monitored in all 15 areas. In addition the airport is equipped with a permanent flight track and noise monitoring system. The noise situation both in the study period and on an average basis can therefore be accurately described. In August a group of 1800 new respondents were subjected to identical interviews in the same 15 areas, and the noise measurement program was repeated. Results of the study are discussed.
Author

N90-24873*# Army Construction Engineering Research Lab., Champaign, IL.
HUMAN RESPONSE RESEARCH UPDATE
Paul D. Schomer *In* NASA, Langley Research Center, FAA/NASA En Route Noise Symposium Apr. 1990 p 303-309 (For primary document see N90-24853 18-71)
Avail: NTIS HC A14/MF A02 CSCL 20A

The methods, sources, instrumentation, the new facility at Aberdeen Proving Grounds, (APG) performance tests, and APG sources are briefly outlined. This presentation is represented by viewgraphs only.
Author

N90-24874 Council for National Academic Awards (England).
SOLUTION OF EXTERIOR ACOUSTIC PROBLEMS BY THE BOUNDARY ELEMENT METHOD Ph.D. Thesis
Stephen Martin Kirkup 1989 304 p
Avail: Univ. Microfilms Order No. BRDX87717

The boundary element method is described and investigated, especially in respect of its application to exterior two-dimensional Laplace problems. Both empirical and algebraic analyses (including the effects of approximation of the boundary and boundary functions and the precision of the evaluation of the discrete forms) are developed. Methods for the automatic evaluation of the discrete forms of the Laplace and Helmholtz integral operators are reviewed and extended. Boundary element methods for the solution of exterior Helmholtz problems with general (but most importantly Neumann) boundary conditions are reviewed and some are explicitly stated using a new notation. Boundary element methods based on the boundary integral equations introduced by Brakhage and Werner/Leis/Panich/Kussmaul (indirect) and Burton and Miller (direct) are given prime consideration and implemented for three-dimensional problems. The influence of the choice of weighting parameter on the performance of the methods is explored and further guidance is given. The application of boundary element methods and methods based on the Rayleigh integral to acoustic radiation problems are considered. Methods for speeding up their solution via the boundary element method are developed. Library subroutines for the solution of acoustic radiation problems are described and demonstrated. Computational techniques for the problem of predicting the noise produced by a running engine are reviewed and appraised. The application of the boundary element method to low-noise engine design and in the design of noise shields is considered. The boundary element method is applied to the Ricardo crankcase simulation rig, which is an engine-like

structure. A comparison of predicted and measured sound power spectra is given. Dissert. Abstr.

N90-24875# Ohio State Univ., Columbus. Dept. of Welding Engineering.
INVESTIGATIONS OF ULTRASONIC WAVE INTERACTIONS AT IMPERFECT BOUNDARIES SEPARATING ANISOTROPIC MATERIALS Progress Report
1989 11 p
(Contract DE-FG02-84ER-45057)
(DE90-010661; DOE/ER-45057/5) Avail: NTIS HC A03/MF A01

The main objective of the current research effort is to obtain a better understanding of ultrasonic wave interaction with imperfect interfaces in polycrystalline materials. In accordance with the previous research proposal, this effort was focused on five specific areas of particular interest which will be discussed separately. DOE

N90-24876# Centro Italiano Ricerche Aerospaziali, Naples.
PROBLEMS OF INTERNAL ACOUSTICS IN TWO AND THREE DIMENSIONAL CAVITIES WITH DEFORMABLE WALLS USING THE MSC/NASTRAN CODE [PROBLEMI DI ACUSTICA INTERNA IN CAVITA' 2D E 3D A PARETI DEFORMABILI CON MSC/NASTRAN]
S. DeRosa and M. Cavaliere 14 Feb. 1989 194 p Partly in ENGLISH and ITALIAN
(DLC/STR-INT-TN-004; ETN-90-96565) Avail: NTIS HC A09/MF A01

A finite element computer code is used to examine the acoustic fields in typical aircraft cabins. Nastran and Patran codes are used because of their versatility and worldwide utilization. Experimental results and comparison with analytical methods are presented. The interactions between the vibrating structure and the induced pressure field in the cavity fluid are demonstrated. ESA

N90-24877# Naval Ocean Systems Center, San Diego, CA.
NORMAL-MODE AND PHASE-INTEGRAL METHODS FOR DETERMINING PHASE AND GROUP VELOCITIES IN SIMPLE UNDERWATER ACOUSTIC DUCTS Final Report, Apr. 1986 - Mar. 1989
M. A. Pedersen, D. F. Gordon, and F. Hosmer Feb. 1990 39 p
(AD-A221393; NOSC/TR-1331) Avail: NTIS HC A03/MF A01 CSCL 20/1

This theoretical report compares normal-mode and phase-integral results for three simple classes of ducts. These classes are a positive-gradient half space bounded above by a free or a rigid surface and an unbounded refractive duct. The major interest in these simple ducts is that the analysis leads to the concept of canonical eigenvalues. The term canonical is used because the eigenvalues apply to an entire class of sound-speed profile rather than to one specific profile as in the customary eigenvalue approach. The general canonical eigenvalue equation contains two dimensionless mathematical variables and a set of dimensionless coefficients that are functions of the profile parameters. The normal-mode and phase-integral results for unbounded refractive ducts are compared with modal results for a double-duct profile with two refractive ducts. Modal results for the two models agree when the double-duct phase velocities of adjacent modes are well separated. GRA

N90-24878# Stanford Univ., CA. Lab. of Physics.
MILLIMETER-WAVE ACOUSTIC TRANSDUCERS Final Report, 1 Jun. 1987 - 30 Sep. 1989
C. F. Quate, L. J. LaComb, Jr., and D. R. Wright Apr. 1990 74 p
(Contract N00014-87-K-0447)
(AD-A221402; SU-GL-4680) Avail: NTIS HC A04/MF A01 CSCL 20/1

This project was focused on a program to realize efficient systems for generating and detecting coherent phonons with millimeter wavelengths. The primary task was the realization of transducers that are capable of converting electromagnetic energy to acoustic energy in this frequency region. In order to increase the operating frequency, the components of the acoustic transducer must be redesigned. Instead of the single layer ZnO acoustic transducers used below 10 GHz, multilayer ZnO acoustic transducers must be used to generate sufficient power at frequencies above 24 GHz. In association with all of this we have continued to investigate the nature of acoustic wave propagation in liquid helium. GRA

N90-24879# Ecole Nationale Superieure des Telecommunications, Paris (France). Groupe Acoustique.
PERCUSSIVE SOUND ANALYSIS USING AN AUTOREGRESSIVE MODEL. APPLICATION OF MODIFIED COVARIANCE Thesis - Maine Univ. [ANALYSE DE SONS PERCUSSIFS PAR MODELE AUTOREGRESSIF. APPLICATION DE LA COVARIANCE MODIFIEE]
Jean-Louis Meillier 1989 77 p In FRENCH
(Telecom-Paris-89-D-016; ISSN-0751-1345; ETN-90-96959)
Avail: NTIS HC A05/MF A01

A modified covariance method is used to follow the evolution of frequency content of percussive sound. This parametric sound analysis method is used to better understand the percussive signals produced by instruments such as the piano and plucked string instruments. The limitations of Fourier analysis for use in spectral analysis are quickly reached. It cannot take into account the rich transitory sound produced by the initial attack of percussive sound. This attack lasts from 3 to 50 ms depending on the instrument. It is concluded that the initial attack percussive sound needs to be divided into octave bands to be analyzed. There is otherwise too great a range of sound for analysis to be possible. ESA

N90-24880# Idaho National Engineering Lab., Idaho Falls.
APPLICATIONS OF AN ACOUSTIC-EMISSION DATA-ACQUISITION WORKSTATION: 2
John A. Johnson and Nancy M. Carlson 1989 9 p Presented at the 16th Annual Review of Progress in Quantitative Nondestructive Evaluation, Brunswick, ME, 23-28 Jul. 1989
(Contract DE-AC07-76ID-01570)
(DE90-010941; EGG-M-89124; CONF-890770-11) Avail: NTIS HC A02/MF A01

An eight-channel data acquisition system is used to acquire and analyze acoustic emission (AE) data from aluminum surface crack specimens. The data acquisition system and an automatic method of analysis are described in a previous paper. Herein, a semiautomatic data analysis method for determining the source locations is described, and the results form tests on aluminum specimens are discussed. DOE

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N90-24881*# Arizona Univ., Tucson. Dept. of Physics and Astronomy.
AXIONS AND SN 1987A: AXION TRAPPING
Adam Burrows, M. Ted Ressell, and Michael S. Turner (Chicago Univ., IL.) May 1990 30 p Prepared in cooperation with Fermi National Accelerator Lab., Batavia, IL
(Grants NASw-1340; NSF AST-87-14176; NSF AST-89-14346)
(NASA-CR-186604; NAS 1.26:186604; Fermilab-Publ-90/81-A)
Avail: NTIS HC A03/MF A01 CSCL 20H

If an axion of mass between about 10(exp -3) eV and 1 eV exists, axion emission would have significantly affected the cooling of the nascent neutron star associated with SN 1987A. For an axion of mass less than about 10(exp -2) eV, axions produced deep inside the neutron star simply stream out; in a previous paper this case has been addressed. Remarkably, for an axion of mass greater than about 10(exp -2) eV axions would, like neutrinos, have a mean-free path that is smaller than the size of a neutron star, and thus would become 'trapped' and radiated from an axion

sphere. In this paper the trapping regime is treated by using numerical models of the initial cooling of a hot neutron star that incorporate a leakage approximation scheme for axion-energy transport. The axion opacity is computed due to inverse nucleon-nucleon, axion bremsstrahlung, and numerical models are used to calculate the integrated axion luminosity, the temperature of the axion sphere, and the effect of axion emission on the neutrino bursts detected by the Kamiokande 2 (K2) and Irvine-Michigan-Brookhaven (IMB) water-Cherenkov detectors. The larger the axion mass, the stronger the trapping and the smaller the axion luminosity. The earlier estimate is confirmed and refined of the axion mass above which trapping is so strong that axion emission does not significantly affect the neutrino burst. Based upon the neutrino-burst duration--the most sensitive barometer of axion cooling--it is concluded that for an axion mass of greater than about 0.3 eV, axion emission would not have had a significant effect on the neutrino bursts detected by K2 and IMB. The present work, together with the previous work, strongly suggests that an axion with mass in the interval 10(exp -3) eV to 0.3 eV is excluded by SN 1987A. Author

N90-24882# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

ATOM INTERFEROMETRY PROGRESS Annual Technical Report, 1 Dec. 1988 - 30 Nov. 1989

David E. Pritchard, Chris R. Ekstrom, David Keith, Bruce G. Oldaker, and Quentin Turchette 19 Apr. 1990 6 p

(Contract N00014-89-J-1207)

(AD-A220875) Avail: NTIS HC A02/MF A01 CSCL 14/2

An atom interferometer is constructed in which the atom waves are physically separated prior to being recombined. Fabricated transmission gratings are used as optical elements for the matter waves. Atom interferometers should be useful in studies of atomic properties, tests of basic quantum physics, for metrology, as rotation sensors, and perhaps ultimately as devices to make ultra-small structures using atom holograms. During the last year the atom interferometer has evolved from a rough plan to an essentially complete device. At present all the major components of the interferometer have been built, and tested at least once. The system will be given its first real try in the next year. The interferometer consists of three 0.2 microns period diffraction gratings equally spaced approx. 0.65 m apart in the atomic beam machine. The maximum separation of the beams will be approx. 60 microns. The first two gratings separate and redirect the atomic beam forming a standing wave interference pattern in the atomic flux at the third grating, which acts like a mask to sample this pattern. A principle technical obstacle is the mechanical vibrations of the machine which will blur the interference pattern. GRA

N90-24883# Technische Univ., Eindhoven (Netherlands).

TIME-RESOLVED SWARM STUDIES IN GASES WITH EMPHASIS ON ELECTRON DETACHMENT AND ION CONVERSION Ph.D. Thesis

Chuan Wen 1989 173 p

(ISBN-90-9003013-1; ETN-90-96898) Avail: NTIS HC A08/MF A01

Processes responsible for avalanche growth were investigated with emphasis on electron detachment and ion conversion processes, and their impact on the avalanche properties and on the dielectric behavior of the gases studied. These delaying processes determine the production rate of delayed electrons and the experimental technique used is a time resolved swarm method. Bandwidth limitations of the time resolved current measurement were analyzed, resulting in an improved measuring system. A hydrodynamic model which accounts for electron and ion drift, electron diffusion, ionization, attachment, electron detachment and ion conversion was set up, and analytical solutions obtained. Swarm experiments were performed for N2, SF6, dry air, O2, 1-C3F6, C-C4F8, and CCl2F2. The evaluation of the measured avalanche current waveforms show that delaying processes are responsible for reported abnormal dielectric behavior. ESA

N90-24884# Amsterdam Univ. (Netherlands).

THE BEHAVIOUR OF THE L3 MUON CHAMBERS IN A MAGNETIC FIELD Ph.D. Thesis

Johannes Onvlee 1989 112 p Sponsored by Stichting voor Fundamenteel Onderzoek der Materie

(ETN-90-96920) Avail: NTIS HC A06/MF A01

Different parts of the L3 detector (one of 4 detectors in the collider developed for experimental high energy physics in the Large Electron Positron (LEP) facility) are detailed. The magnetic field of L3 is described. Results of different drift velocity and diffusion measurements are presented. The drift velocity as function of the electric field was measured at B = 0.5 Telsa. Effects playing a role in the drift time drift distance relation are discussed. Data from a testbeam experiment are analyzed, and a technique is suggested to remove systematic errors found. ESA

N90-24885# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

TRAPS FOR NEUTRAL ATOMS Annual Summary Progress Report, 1 Sep. 1983 - 31 Jan. 1990

David E. Pritchard 31 Jan. 1990 7 p

(Contract N00014-83-K-0695)

(AD-A220925) Avail: NTIS HC A02/MF A01 CSCL 14/2

Two atom traps were demonstrated, one magnetic and one using light forces. In each case ours was the second trap of that type, embodying significant new conceptual contributions which permitted tremendous advances over the previous trap of that type (in each case by about 100000 in number trapped, and 100 in time trapped). Both of the designs were used without improvement by other groups: Meanwhile, only one new trap was demonstrated; a light trap which performed less well than ours. This suggest that major advances in atom traps will no longer appear with regularity. GRA

N90-24886# Technische Univ., Eindhoven (Netherlands).

FEW-BODY COLLISIONS IN A WEAKLY INTERACTING BOSE GAS Ph.D. Thesis

Hendricus Theodorus Stoof 1989 96 p Sponsored by Netherlands Organization for Scientific Research and Government of the Land Nordhein-Westfalen, Fed. Republic of Germany

(Grant NATO-0543/88)

(ETN-90-96893) Avail: NTIS HC A05/MF A01

Cold collision and their role in experiments aiming at the achievement of Bose-Einstein condensation in spin polarized atomic hydrogen gas are studied. Some of the subjects studied pertain primarily to the more traditional high density experimental scheme including its recent variants, others to low density experiments involving magnetic traps and other advanced experimental techniques. The Bogoliubov theory and elementary-boson picture of atomic hydrogen used in the study are discussed. The decay constants for exchange and dipolar relaxation due to two body collisions are determined. The theory of three body scattering and the evaluation of the rate constant for three body dipolar recombination are studied. Resonances due to H3 molecular states are found to be of utmost importance for the understanding of the recombination process. ESA

N90-24887# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Physics.

MONOENERGETIC POSITRON BEAM STUDIES OF NEAR-SURFACE PHENOMENA Ph.D. Thesis

Heikki Huomo 1989 11 p missaeaettoe; and Brookhaven National Laboratory missaeaettoe; And Brookhaven National Laboratory

(ETN-90-96947) Avail: NTIS HC A03/MF A01

Studies of irradiation induced defects with positrons obtained directly from a radioactive source are presented. The development of monochromatic positron beams is described. Measurement of basic positron interaction mechanisms and application of the slow positron beam technique to studies of spatial distributions of defects close to sample surfaces are outlined. The importance of better understanding the interaction of defects and impurities in initiating

and enhancing embrittlement and fatigue is stressed. Application of the research results in choosing construction materials for the first wall of fusion reactors is described. ESA

N90-24888# Sandia National Labs., Albuquerque, NM.
AN EXAMINATION OF THE 1-MeV EQUIVALENT SILICON DAMAGE METHODOLOGY
P. J. Griffin, J. G. Kelly, T. F. Luera, and M. S. Lazo (New Mexico Univ., Albuquerque.) 1990 9 p Presented at the 27th IEEE Annual International Nuclear and Space Radiation Effects Conference, Reno, NV, 16-20 Jul. 1990
(Contract DE-AC04-76DP-00789)
(DE90-007167; SAND-90-0341C; CONF-900723-4) Avail: NTIS HC A02/MF A01

The assumptions, approximations, and uncertainty in the 1-MeV equivalent silicon damage methodology are reviewed. A new silicon displacement kerma (Kinetic Energy Released in MAterials) function, based on ENDF/B-VI cross sections, is presented and its shape is experimentally confirmed. The issue of an associated 1-MeV equivalent reference kerma value is discussed. DOE

N90-24889# Pacific Northwest Lab., Richland, WA. Molecular Science Research Center.
WORKSHOP ON HIGH-FIELD NMR AND BIOLOGICAL APPLICATIONS
1989 67 p Workshop held in Richland, WA, 8-9 Sep. 1989
(Contract DE-AC06-76RL-01830)
(DE90-010002; PNL-SA-18016; CONF-8909305) Avail: NTIS HC A04/MF A01

Scientists at the Pacific Northwest Laboratory have been working toward the establishment of a new Molecular Science Research Center (MSRC). The primary scientific thrust of this new research center is in the areas of theoretical chemistry, chemical dynamics, surface and interfacial science, and studies on the structure and interactions of biological macromolecules. The MSRC will provide important new capabilities for studies on the structure of biological macromolecules. The MSRC program includes several types of advanced spectroscopic techniques for molecular structure analysis, and a theory and modeling laboratory for molecular mechanics/dynamics calculations and graphics. It is the goal to closely integrate experimental and theoretical studies on macromolecular structure, and to join these research efforts with those of the molecular biological programs to provide new insights into the structure/function relationships of biological macromolecules. One of the areas of structural biology on which initial efforts in the MSRC will be focused is the application of high field, 2-D NMR to the study of biological macromolecules. First, there is interest in obtaining 3-D structural information on large proteins and oligonucleotides. Second, one of the primary objectives is to closely link theoretical approaches to molecular structure analysis with the results obtained in experimental research using NMR and other spectroscopies. DOE

N90-25044*# Bethune-Cookman Coll., Daytona Beach, FL. Div. of Science and Mathematics.
A 3D VISUALIZATION SYSTEM FOR MOLECULAR STRUCTURES Abstract Only
Terry J. Green *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 73 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20H

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

N90-24890# Los Alamos National Lab., NM.
GAS PRODUCTION AND BEHAVIOR IN THE COOLANT OF THE SP-100 SPACE NUCLEAR POWER SYSTEM Ph.D. Thesis
John Morton McGhee Aug. 1989 318 p
(Contract W-7405-eng-36)
(DE90-010674; LA-11629-T) Avail: NTIS HC A14/MF A02

The radiologic generation and subsequent behavior of helium gas in the lithium coolant of SP-100 class space nuclear power reactors was investigated analytically in a two part study. Part One of the study consisted of a calculation of coolant radiologic helium gas production rates in a SP-100 class reactor using the discrete ordinates code TWODANT. Cross sections were developed from ENDF/B-V data via the MATXS6s master cross section library. Cross sections were self shielded assuming one homogeneous core region, and Doppler broadened to 1300 K using the cross section preparation code TRANSX. Calculations were performed using an S sub 4/P sub 1 approximation and 80 neutron energy groups. Part Two of the study consisted of a theoretical investigation into the behavior of helium gas in the primary loop of lithium cooled space reactors. The SP-100 space power system was used as a representative of such a system. Topics investigated included: (1) heterogeneous and homogeneous nucleation; (2) bubble growth/collapse by diffusion, mechanical temperature/pressure effects, and coalescence; and, (3) the effects on bubble distribution of microgravity, magnetic fields, and inertially induced buoyancy. DOE

N90-24891# General Atomic Co., San Diego, CA.
TFE VERIFICATION PROGRAM Semiannual Report, period ending 30 Sep. 1989
Mar. 1990 148 p
(Contract DE-AC03-86SF-16298; GA Proj. 3450)
(DE90-008227; GA-A-19876) Avail: NTIS HC A07/MF A01

The information presented herein will include evaluated test data, design evaluations, the results of analyses and the significance of results. The program objective is to demonstrate the technology readiness of a Thermionic Fuel Element (TFE) suitable for use as the basic element in a thermionic reactor with electric power output in the 0.5 to 5.0 MW(e) range, and a full-power life of 7 years. The TF Verification Program builds directly on the technology and data base developed in the 1960s and 1970s in an AEC/NASA program, and in the SP-100 program conducted in 1983, 1984 and 1985. In the SP-100 program, the attractive features of thermionic power conversion technology were recognized but concern was expressed over the lack of fast reactor irradiation data. The TFE Verification Program addresses this concern. The general logic and strategy of the program to achieve its objectives is shown. Five prior programs form the basis for the TFE Verification Program: (1) AEC/NASA program of the 1960s and early 1970; (2) SP-100 concept development program; (3) SP-100 thermionic technology program; (4) Thermionic irradiations program in TRIGA in FY-88; and (5) Thermionic Program in 1986 and 1987. DOE

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N90-24892# Aware, Inc., Cambridge, MA.
THE PERFORMANCE OF WAVELETS FOR DATA COMPRESSION IN SELECTED MILITARY APPLICATIONS Final Report, 28 Aug. - 27 Dec. 1989
Howard L. Resnikoff (Atlantic Aerospace Electronics Corp., Greenbelt, MD.) 23 Feb. 1990 61 p

(Contract F49620-89-C-0122)
(AD-A219230; AWARE-TR-AD-900223; AFOSR-90-0288TR)
Avail: NTIS HC A04/MF A01 CSCL 20/6

Wavelets provide a new mathematical and computational approach to representing image data. A wavelet basis is a complete orthonormal system of functions in terms of which image data can be represented. The low computational complexity of the wavelet transform and the bounded support of the wavelet basis functions off high retention of information that typically corresponds to image features, and low workload for computing, compressing, and reconstituting image data. Aware conducted computational experiments to determine the contribution of wavelets to solving two classes of practical problem: (1) Position location by matching observations to a stored image; and (2) Identification of objects of specific size or characteristics and sensory clutter. The results suggest that compression using wavelets preserves more than enough information to register position correctly using position reconstituted reference images that have been compressed in excess of 100:1. A variety of analysis made to develop an indication of the relationship between information loss and compression are reported. GRA

N90-24893# Aware, Inc., Cambridge, MA.
THE PERFORMANCE OF WAVELETS FOR DATA COMPRESSION IN SELECTED MILITARY APPLICATIONS. VOLUME 2: SUPPLEMENTARY TABLES AND GRAPHS Final Report
28 Jan. 1990 426 p
(Contract F49620-89-C-0122)
(AD-A219231; AWARE-TR-AD-900223-Vol-2; AFOSR-90-0288TR-Vol-2) Avail: NTIS HC A19/MF A03 CSCL 12/1

Some tables and graphs illustrating the following topics are presented: Value of Correlation at Correct Location vs. Compression; Value of Max Laplacian vs. Compression; Value of Max Smoothed Laplacian vs. Compression; Ratio of Peak Correlation to that of Largest and Nearest Side Lobes vs. Compression; Ratio of Peak Laplacian to that of Largest and Nearest Side Lobes vs. Compression; Correlation Side Lobe to Peak Ratio vs. Radial Distance; Laplacian Sidelobe to Peak Ratio vs. Radial Distance; Laplacian vs. Radial Distance, Experimental Data; and Laplacian of correlation of A1 W1 (at various scalings) with A1 (at a given compression) vs. Radial Distance. GRA

N90-24894# Standard Telephones and Cables Ltd., Harlow (England).
NOVEL PULSED PLASMA TREATMENT AND COATING PROCESS: MULTILAYER STRUCTURES FOR OPTICAL COMPUTING APPLICATIONS Final Report, Aug. 1988 - Dec. 1989
I. P. Llewellyn and R. A. Heinecke 15 Mar. 1990 26 p
(Contract N00014-87-J-1258)
(AD-A220737; STL-IR/503/1990/1488) Avail: NTIS HC A03/MF A01 CSCL 20/6

The objective of this work has been to develop the technique and equipment required to use a pulsed plasma deposition process to produce amorphous multi-quantum well layered materials with layer thickness down to a few atoms. Such structures have many possible uses in defence-related areas, but at the request of SDI, work has concentrated on the use of the technique to produce non-linear optical materials with high third-order susceptibility for use in optical computing devices. In particular, films based on thin layers of chalcogenide glasses show large non-linear effects of similar magnitude to those seen in optical filters, and have demonstrated that it may be possible to construct very fast optical devices (less than 250 ps) using this technique. Furthermore, this technology should be readily integrated with passive optical components such as optical filters in order to produce all the necessary elements for a parallel computing system. GRA

N90-24895# Pennsylvania State Univ., University Park. Dept. of Chemistry.
SECOND ORDER NON-LINEAR OPTICAL POLYPHOSPHAZENES
Alexa A. Dembek, Harry R. Allcock, Chulhee Kim, William H. Steier, Charles W. Spangler, Robert L. S. DeVine, and Shi Yongquiang (University of Southern California, Los Angeles.) 23 Mar. 1990 25 p Presented at a Symposium on Non-Linear Optics, ACS Meeting, Boston, MA, 1990
(Contract N00014-84-K-0477)
(AD-A219868; TR-55-ONR) Avail: NTIS HC A03/MF A01 CSCL 07/6

In this contribution, we describe the synthesis and second-order optical properties of a series of mixed-substituent poly(organophosphazenes) that possess covalently attached donor-acceptor substituted, conjugated moieties. The general structure of the polymer is (NP(OCH2CF3)x(OR)(y))(n), where OR = -O(CH2O) (k)C6H4-CH=CH-C6H4NO2; where k = 1-3, and -OCH2CH2N(CH2CH3)C6H4-N=N-C6H4NO2, and x + y = 100 percent. The nonlinear optical properties of thin films of the polymers were investigated by using second harmonic generation, giving second-harmonic coefficients, d(33), in the range 4.1 to 34 pm/V. GRA

N90-24896# Naval Postgraduate School, Monterey, CA.
THE EFFECT OF RANDOM VARIATIONS OF RADIOSONDE DATA ON THE PREDICTED FLIR PERFORMANCE CALCULATED BY THE PROGRAM UFLR M.S. Thesis
Rodolfo Reategui Sep. 1989 342 p
(AD-A220034) Avail: NTIS HC A15/MF A02 CSCL 17/5

The lack of correlation between the Airborne Forward Looking Infrared Detector predicted performance by the program UFLR and the actual performance due to meteorological fluctuations was examined. Calculated performances for the detection, classification and identification of four surface targets using actual radiosonde profiles were compared to the performances using radiosonde data affected by random atmospheric variations of pressure, temperature and relative humidity. A total of 192 performances were created using this method. A visual display and a statistical analysis of the actual and simulated performances was performed. Error margins were determined in the predicted detection ranges for height levels of 1,500 ft, 5,000 ft and 10,000 ft. It was also determined that the FLIR performance may be degraded up to 10 nautical miles for a height level of 5,000 ft, and up to 12 nautical miles for a height level of 10,000 ft due to the random atmospheric variations. GRA

N90-24897# North Carolina State Univ., Raleigh. Dept. of Electrical and Computer Engineering.
OPTICAL SIGNAL PROCESSING Final Report, 20 Nov. 1986 - 31 Jan. 1990
A. VanderLugt 28 Feb. 1990 105 p
(Contract DAAL03-87-K-0011)
(AD-A220332; Rept-24782-F; ARO-24782.11-PH) Avail: NTIS HC A06/MF A01 CSCL 09/5

Optical techniques to detect and track frequency hopped radio signals in a dense electromagnetic environment is studied by using cross-spectrum of two signals obtained from antenna elements spaced by one-half an RF wavelength. The array was decimated by retaining only every Mth element and scan the cross-spectrum past the decimated array. The circuit complexity was reduced, but suffer some loss in system performance because more photodetector bandwidth is required to accommodate the scanning action. An extension of the decimated array concept is to decimate the reference waveform in the heterodyne spectrum analyzer. In this case, only 64 optical probes in the Fourier domain was generated instead of the 2048 that are normally required. The advantage is that all of the optical power in the reference beam can be concentrated into the reduced number of optical probes, thereby offsetting some of the intrinsic loss in performance experienced by the cross-spectrum analyzer. GRA

N90-24898# California Univ., Berkeley. Lawrence Berkeley Lab. Center for X Ray Optics.
X RAY OPTICS Final Report, 15 Oct. 1986 - 29 Sep. 1989
David T. Attwood, Jr. Jan. 1990 29 p Prepared in cooperation with California Univ., Berkeley
(Contract F49620-87-K-0001; AF Proj. 2301)
(AD-A221218; AFOSR-90-0518TR) Avail: NTIS HC A03/MF A01 CSCL 20/8

Progress was made in diffractive x ray microscopy, multilayer mirrors for x ray imaging and laser applications, soft x ray imaging and spectroscopy of biological samples, and computer simulations of x ray optical trains. GRA

N90-24899# Riverside Research Inst., New York, NY.
INNOVATIVE TECHNIQUES FOR HIGH-RESOLUTION IMAGING AND PRECISION TRACKING Final Technical Report
J. Nowakowski, D. Gutkowicz-Krusin, and G. Lind 20 Apr. 1990 102 p
(Contract N00014-89-C-0124)
(AD-A221380; RRI-FR-1/C49-701) Avail: NTIS HC A06/MF A01 CSCL 20/6

Collection of quantitative data on signatures of space objects requires knowledge of atmospheric transmission at the geographical site of interest. A method for direct measurement utilizing a unique real-time multipath laser radar is described. Techniques are analytically evaluated for optical autodyne detection which offers the potential of improving the performance of passive and conventional active sensors in detection, recognition and tracking. Optical autodyne detection is a direct detection method for measuring relative Doppler shifts using a coherent laser illuminator. Various frequency components of the received optical signal are mixed together on a square law photodetector to produce an output containing the spectrum of frequencies related to the relative velocity spectrum of the target and background components. Fundamental limits are established for the accuracy of the estimation of range and velocity resolution for autodyne detection of a two point target with a pulsed laser radar. The Cramer-Rao bounds were computed for both the signal noise and background limited cases. GRA

N90-24900# Technische Univ., Berlin (Germany, F.R.). Fachbereich Physik.
IMAGE OF THE ANGLE BY PARTIALLY COHERENT LIGHTING: CALCULATIONS AND EXPERIMENTS Ph.D. Thesis [DAS BILD DER KANTE BEI TEILKOHAERENTER BELEUCHTUNG: RECHNUNGEN UND EXPERIMENTE]
Andreas Glindemann 1989 133 p In GERMAN
(ETN-90-96505) Avail: NTIS HC A07/MF A01

A linear approximation by means of the bilinear transfer function is developed to obtain the properties of the partially coherent transmission with two additive transmission functions. The approximation was compared with the exact calculation for absorption and phase angles by focused and defocused image transformation. A good agreement was found with the linear approximation, which is often used for the interpretation of the image intensity of the phase and absorption angles and allows the defocusing influence on the image intensity to be described by means of the transfer functions. ESA

N90-24901# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Image.
ANALYSIS OF CAMERA MOVEMENT BASED ON A SEQUENCE OF IMAGES [ANALYSE DU MOUVEMENT D'UNE CAMERA A PARTIR D'UNE SEQUENCE D'IMAGE]
Yifeng Wu Nov. 1989 70 p In FRENCH Prepared in cooperation with Matra Espace, Paris-Velizy, France
(Telecom-Paris-89-D-008; ISSN-0751-1345; ETN-90-96953)
Avail: NTIS HC A04/MF A01

Dynamic scene analysis, with particular attention given to the interpretation of speed fields is discussed. The fundamental methods and formulas used in such analysis are presented. Ways in which to decompose the parameters of movement and an analysis of the relationship between these parameters and the three-dimensional structure of the scene are discussed. A least squares method is used to solve the problem. This approach is only possible when dealing with a pure translation or a pure rotation. In general cases one must depend on iterative resolutions which present convergence and stability limitations unless the initial estimate is very good. ESA

N90-24902# Lawrence Livermore National Lab., CA. Dept. of Chemistry and Materials Science.
ADVANCED MULTILAYER X RAY OPTICS
Troy W. Barbee, Jr. 30 Mar. 1990 13 p
(Contract W-7405-eng-48)
(DE90-008228; UCRL-ID-103509) Avail: NTIS HC A03/MF A01

Multilayer optics for the x ray, soft x ray and extreme ultra violet is a rapidly expanding and maturing field. A large part of the effort is directed to improving the quality of multilayer structures by developing a better understanding of synthesis-structure-property relationships. Although the quality of simple multilayer structures may be improved there are now significant instrumental applications for these reflecting structures and opportunities for the development of new optics. Results on a new class of diffraction grating, the multilayer grating, and two instruments, a multilayer two element fixed exit beam monochromator and a multilayer Cassegrain astronomical telescope, are presented and the implications discussed. DOE

N90-24468# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).
GALACTICAL ULTRA WIDE ANGLE SCHMIDT SYSTEM
T. Miski and K.-H. Weber *In* ESA, Fourth European Space Mechanisms and Tribology Symposium Mar. 1990 p 39-44
(For primary document see N90-24462 18-31)
Copyright Avail: NTIS HC A14/MF A02

N90-24986*# Missouri Univ., Independence. Dept. of Electrical and Computer Engineering.
OPTICAL CALCULATION OF CORRELATION FILTERS FOR A ROBOTIC VISION SYSTEM Final Report
Jerome Knopp *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 7 p
(For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 20A

N90-24997*# Stevens Inst. of Tech., Hoboken, NJ. Dept. of Electrical Engineering and Computer Science.
OPTICAL RATE SENSOR ALGORITHMS Final Report
Jo A. Uhde-Lacovara *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 11 p
(For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 20F

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N90-24903# Nagoya Univ. (Japan). Inst. of Plasma Physics.
PROCEEDINGS OF SYMPOSIUM ON PRODUCTION AND TARGET INTERACTION OF PARTICLE BEAM
Keishiro Niu, ed. Mar. 1989 178 p Symposium held in Nagoya, Japan, 22-23 Dec. 1988
(IPPJ-900; ISSN-0469-4732) Avail: NTIS HC A09/MF A01

A symposium was held on Production and Target Interaction of Particle Beams at the Institute of Plasma Physics. A compilation of reports from the conference is presented. The conference covered such topics as high temperature superconductor lens systems, ion beam production methods, laser diagnosis on magnetically insulated pulse ion diodes, and beam propagation in plasma channels. M.G.

N90-24904# Polytechnic Univ., Farmingdale, NY.
FAST PLASMA MIXING: A NEW EXCITATION METHOD FOR CW GAS LASERS Final Report, 1 May 1986 - 31 Oct. 1989
Gerhard Schaefer and H. Kirkici 15 Mar. 1990 64 p
(Contract DAAG03-86-K-0051)
(AD-A220290; POLY-WRI-1573-90; ARO-23393.3-PH) Avail: NTIS HC A04/MF A01 CSCL 09/3

Resonant and near resonant energy and charge transfer collisions to molecules are effective mechanisms to generate population inversions in gas lasers. A new technique (fast plasma mixing) has been developed in which metastables and ions are generated separately in a flowing plasma source and then mixed with a molecular beam. Two CW systems, based on a flowing hollow cathode and a constricted arc have been designed. Experiments with several molecular systems have demonstrated selective excitation of atoms, molecules, molecular ions, and excimers. Spectroscopic investigations allowed determining branching ratios and the geometric distribution of the excitation in the mixing volume. CW laser action was achieved in oxygen and fluorine and experiments were performed to clarify the excitation mechanisms. First experiments on ArF and KrF excimer generation were performed and the fluorescence profiles were investigated depending on operating parameters. GRA

N90-24905# Los Alamos National Lab., NM.
CHARACTERIZATION OF PLASMA FLOW THROUGH MAGNETIC NOZZLES Final Report, 5 May 1986 - 30 Apr. 1987
Richard A. Gerwin, George J. Marklin, Anthony G. Sgro, and Alan H. Glasser Feb. 1990 172 p
(AF Proj. 5730)
(AD-A221044; RPL-69018; AL-TR-89-092) Avail: NTIS HC A08/MF A01 CSCL 21/3

An account of research undertaken to describe the steady, axisymmetric flow of plasmas through rocket nozzles, with attention directed to the use of magnetic fields for guiding or propelling the plasmas is reported. The primary emphasis is on simply connected nozzles containing strictly longitudinal (B sub r, O, B sub z) magnetic fields to guide the plasma, with secondary consideration given to annular nozzles containing strictly azimuthal (O, B sub theta, O) magnetic fields to propel the plasma. The possibility and desirability of using hot plasmas in a repetitive mode is discussed, and motivates our consideration of an extensive range of parameters. Although slightly ionized gases having low temperatures (a fracture of an eV) and low magnetic Reynolds numbers often are the objects of valid and useful research (for example, in connection with MHD generators, with MPD thrusters, and with arc heaters to provide sources of hot gas for expanding gas-dynamic flow fields), the focus is upon the effective and efficient interaction of substantial plasmas with guiding or driving magnetic fields. Thus, focus is primarily on highly ionized plasmas that are not dominated by resistive dissipation. Some of the principal physics issues associated with these concepts are addressed. GRA

N90-24906# Maryland Univ., College Park. Lab. for Plasma Research.
MICROWAVE GENERATION FOR MAGNETIC FUSION ENERGY APPLICATIONS Progress Report, 15 Sep. 1989 - 14 Sep. 1990
T. M. Antonsen, Jr., W. W. Destler, V. L. Granatstein, B. Levush, I. D. Mayergoyz, and A. Singh May 1990 55 p
(Contract DE-FG05-87ER-52147)
(DE90-011042; DOE/ER-52147/3) Avail: NTIS HC A04/MF A01

The goal is the development of an electron cyclotron resonance heating (ECRH) scheme for magnetic fusion plasmas such as the Compact Ignition Tokamak (CIT). The approach is the development of a free electron laser using a sheet electron beam and a short period wiggler magnet. The specific requirements for the heating method include 10 to 30 MW of average power with pulse durations of several seconds to CW at a frequency near 300 GHz (approx. 600 GHz) in the case of second harmonic (ECRH). Compatible with the experimental nature of the program, radiation frequency flexibility of 30 percent total bandwidth and 5 percent rapid dynamic (approx. less than 10 ms) bandwidth is desirable. As the source will eventually be applied to a reactor, priority is placed upon high system efficiency and reliability. Use of established technologies is encouraged where possible. DOE

N90-24907# Academy of Sciences of the Ukrainian SSR, Kiev. Inst. Teoreticheskoj Fiziki.
KINETIC THEORY OF LOW-FREQUENCY NONLINEAR STRUCTURES IN MAGNETIZED PLASMAS
A. G. Sitenko and P. P. Sosenko 1988 37 p
(DE90-611306; ITP-88-57) Avail: NTIS (US Sales Only) HC A03/MF A01

Kinetic theory of self-consistent nonlinear oscillations in inhomogeneous magnetized plasmas is formulated. Author

N90-24908# Academy of Sciences of the Ukrainian SSR, Kiev. Inst. Teoreticheskoj Fiziki.
RENORMALIZED MICROSCOPIC THEORY OF FLUCTUATIONS IN INHOMOGENEOUS MAGNETIZED PLASMAS
A. G. Sitenko and P. P. Sosenko 1988 44 p
(DE90-611307; ITP-88-58) Avail: NTIS (US Sales Only) HC A03/MF A01

Nonlinear theory of fluctuations in inhomogeneous magnetized plasmas is formulated. Author

N90-24909# Academy of Sciences of the Ukrainian SSR, Kiev. Inst. Teoreticheskoj Fiziki.
FINITE AMPLITUDE SURFACE WAVES IN COOLED PLASMAS WITH SMEARED INTERFACE
V. M. Kuklin, I. P. Panchenko, and V. M. Chernousenko 1988 8 p
(DE90-611308; ITP-88-66) Avail: NTIS (US Sales Only) HC A02/MF A01

The nonlinear dynamics of surface wave propagation in cooled plasmas with smeared interface is discussed. The strong parametric instability with excitation of a short-wave spectrum of the Langmuir vibrations is shown to evolve in the inhomogeneous region near the plasma resonance. At the nonlinear stage of the process the short-wave spectrum exchanges energy with the surface wave. The small quasi-stationary perturbations of electrons density and plasma ions with broken quasi-neutrality condition arise in the vicinity of the plasma resonance. Author

N90-24910# Academy of Sciences of the Ukrainian SSR, Kiev. Inst. Teoreticheskoj Fiziki.
LOW-FREQUENCY OSCILLATIONS IN VLASOV PLASMAS: THE QUADRATIC POLARIZATION APPROXIMATION
P. P. Sosenko 1988 20 p
(DE90-611309; ITP-88-71) Avail: NTIS (US Sales Only) HC A03/MF A01

Nonlinear properties of low-frequency electromagnetic oscillations in inhomogeneous magnetized plasmas are studied. Author

N90-24911# Academy of Sciences (USSR), Novosibirsk. Inst. Yadernoj Fiziki.
SELF-SIMILAR LANGMUIR COLLAPSE
V. M. Malkin and V. N. Khudik 1988 7 p
(DE90-611310; IYaF-88-165) Avail: NTIS (US Sales Only) HC A02/MF A01

The first example of a three-dimensional self-similar solution of Zakharov equations for a supersonic Langmuir wave collapse is constructed. The parameters of this solution differ essentially from those predicted by the model of a highly oblate cavity, in particular, the maximum depth of the cavity exceeds the expected one by nearly four times. An explanation of this discrepancy is given. Author

N90-25053*# Mercer Univ., Macon, GA. Dept. of Electrical and Computer Engineering.
AFE DYNAMIC EFFECTS IN INHOMOGENEOUS PLASMAS Abstract Only
Jeng-Nan Juang *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship

Program 1989 Sep. 1989 p 91-92 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20I

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N90-24912# CryoPower Associates, Los Alamos, NM.
SUPERCONDUCTING PERMANENT MAGNETS Final Report, Jun. 1987 - Aug. 1988
Stefan L. Wipf and Henry L. Laquer Mar. 1990 24 p
(Contract F33615-87-C-2747)
(AD-A218944; CPI-TR-88-01B; CPI-TR-88-02; WRDC-TR-90-2011)
Avail: NTIS HC A03/MF A01 CSCL 20/3

The concept of superconducting permanent magnets or Super-Permanent magnets, with fields trapped in shells or cylinders of Type II superconductors is an old one. Unfortunately, the low values of 0.5 to 1T for the first flux jump field, which is independent of the actual current density, have frustrated its implementation with the classical Type II superconductors. The fact that the flux jump fields for high temperature superconductors should be almost an order of magnitude larger at liquid nitrogen temperatures, allows the reconsideration of these options. Analysis of the hysteresis patterns, based on the critical state model, shows that, if the dimensions are chosen so that the value of the first flux jump field (Bfj) at the given operating temperature, a temporarily applied field of 2Bfj will trap 0.5 Bfj. Thus for a Bfj of 6T, a permanent field of 3T should be trapped with an energy product of 1.8MJ/cu m (225 MGOe). This is five times as large as for the best permanent magnet materials. Means are discussed to verify the analysis and the limitations imposed by the low critical current densities in presently available high temperature superconductors. GRA

N90-24913# CryoPower Associates, Los Alamos, NM.
STABILITY PROJECTIONS FOR HIGH TEMPERATURE SUPERCONDUCTORS Final Report, Jun. 1987 - Aug. 1988
Stefan L. Wipf, Henry L. Laquer, Fredrick J. Edesbuty, and William V. Hassenzahl Mar. 1990 24 p
(Contract F33615-87-C-2747)
(AD-A218945; CPI-TR-88-01B; CPI-TR-88-02; WRDC-TR-90-2012)
Avail: NTIS HC A03/MF A01 CSCL 20/13

The stability of the new high temperature superconducting oxides was analyzed using the methodology developed over the last 25 years for conventional Type II superconductors. The results are presented in graphical form for the temperature range from 4 to 100 K. For a 90 K superconductor the first flux jump field peaks above 7T at 60 K. The adiabatic stability limit increases dramatically. The linear dimension of the minimum propagating zone increases by a factor of 3 to 5, and the quench propagation velocity drops by 4 orders of magnitude. The high temperature superconducting materials will, therefore, have much higher stability than conventional Type II superconductors; their high flux jump fields make ultra-fine multi-filamentary conductors unnecessary, and improve the outlook for tape conductors; the energy to create a propagating zone is increased; but methods of coil protection will have to be modified. GRA

N90-24914# Argonne National Lab., IL. Materials Science Div.
ATOMIC STRUCTURE OF Ag/Ni INTERFACES
Y. Gao and K. L. Merkle Mar. 1990 6 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract W-31-109-eng-38)
(DE90-010053; CONF-900466-12) Avail: NTIS HC A02/MF A01

While in heterophase systems of small lattice parameter differences, misfit dislocations are often formed at the interface, it is not known, whether and in which form, misfit localization occurs when the misfit is very large. The atomic structure of Ag/Ni interfaces (misfit 14 percent) was studied by high-resolution electron microscopy (HREM). A special technique was developed to prepare interface specimens suitable for HREM observations. Lattice statics calculations, using embedded-atom potentials, were performed to determine the structure and energies of Ag/Ni interfaces. The lowest interfacial energy was found for the cube-on-cube orientation and (111) interfaces. This is in agreement with the experimental observation, that all interfaces are strongly faceted with (111)Ag/(111)Ni facets. Misfit localization was found by HREM and computer simulation. The HREM observations will be compared to images derived from image simulations, based on model structures obtained from embedded atom calculations. DOE

N90-24915# Argonne National Lab., IL. Materials Science Div.
EPITAXY OF TiO2 THIN FILM ON SAPPHIRE BY MOCVDVD
H. L. M. Chang, H. You, J. C. Parker, and D. J. Lam Apr. 1990 7 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract W-31-109-eng-38)
(DE90-010054; CONF-900466-13) Avail: NTIS HC A02/MF A01

Epitaxial TiO2 films were successfully grown on sapphire substrate at temperatures from 400 to 800 C by thermally decomposing titanium isopropoxide in the presence of O2 in a cold wall low pressure MOCVD system. Rutile film was grown on sapphire (11(bar 2)0) at 800 C with (101) being the growth plane and (1(bar 1)0) being parallel to sapphire (0001). Anatase film was grown on sapphire (0001) at 400 C with (112) being the growth plane and (1(bar 1)0) being parallel to sapphire ((bar 1)100). The film structure as a function of substrate surface orientation and growth temperature is discussed in detail. DOE

N90-24916# Argonne National Lab., IL. Materials Science Div.
MICROSTRUCTURE OF SPUTTERED SUPERCONDUCTING FILMS OF Bi2Sr2CaCu2O(x) MADE BY LOW-TEMPERATURE, IN SITU GROWTH
D. J. Miller, J. M. Grace, D. B. McDonald, K. E. Gray, R. T. Kampwirth, and B. Driehuys 1990 12 p Presented at the 119th Minerals, Metals, and Metallurgical Society Annual Meeting and Exhibit, Anaheim, CA, 18-22 Feb. 1990
(Contract W-31-109-eng-38; NSF STC-88-09854)
(DE90-010067; CONF-900206-8) Avail: NTIS HC A03/MF A01

Superconducting films of Bi(sub 2)Sr(sub 2)CaCu(sub 2)O(sub x) have been sputtered onto single crystal MgO substrates using an in situ process at a substrate temperature of approximately 645 C. These c-axis oriented films exhibit an extrapolated T(sub c0) of 56 K. Electron microscopy reveals that the films are not smoother than films which were post-annealed at 865 C, and that segregation and second-phase precipitation had occurred. It is evident that surface diffusion during in situ processing can enhance segregation in Bi(sub 2)Sr(sub 2)CaCu(sub 2)O(sub x) films. DOE

N90-24917# Argonne National Lab., IL. Materials Science Div.
CHEMICAL AND CRYSTALLOGRAPHIC PHASE BEHAVIOR IN THE Ba(1-x)K(x)BiO3 SYSTEM
D. G. Hinks, J. D. Jorgensen, D. R. Richards, Shiyou Pei, Ying Zheng, and B. Dabrowski 1990 23 p Presented at the 119th Minerals, Metals, and Metallurgical Society Annual Meeting and Exhibit, Anaheim, CA, 18-22 Feb. 1990 Sponsored in part by American Air Liquide, Inc.
(Contract W-31-109-eng-38; NSF DMR-88-09854)
(DE90-010072; CONF-900206-7) Avail: NTIS HC A03/MF A01

Two types of phase behavior are important in the Ba(sub 1-x)K(sub x)BiO(sub 3) system. The structural phase behavior for the oxygen-stoichiometric material may help in understanding the normal-state electrical properties which, in turn, determine the superconducting properties. The high-temperature chemical phase diagram will give information on the stability of the doped material as a function of temperature and oxygen partial pressure. This will provide direction for the synthesis effort by establishing conditions necessary to prepare high-quality samples as a function

of composition. In the first part of the paper we will discuss a recent investigation of the chemical behavior of the system at one fixed partial pressure of oxygen and present a chemical phase diagram consistent with the results of this work. In the second part of the paper we will describe the crystallographic and superconducting behavior of the system (at full oxygen stoichiometry) as a function of potassium concentration. This will provides information on the structural aspects of the metal-semiconductor phase transition and, hopefully, may provide some information on the superconductivity in the system. DOE

N90-24918# Argonne National Lab., IL. Materials Science Div.
MAGNETIC AND RESISTIVE MEASUREMENTS OF THE UPPER CRITICAL FIELD IN INTWINNED SINGLE CRYSTALS OF YBa2Cu3O(7-DELTA)
G. W. Crabtree, U. Welp, W. K. Kwok, K. G. Vandervoort, and J. Z. Liu (California Univ., Davis.) 1990 17 p Presented at the 25th Yamada Conference on Magnetic Phase Transitions, Osaka, Japan, 13-16 Apr. 1990
(Contract W-31-109-eng-38; NSF STC-88-09854)
(DE90-010083; CONF-9004184-1) Avail: NTIS HC A03/MF A01

DC magnetization measurements of H(sub c2) are used to establish a 3D Ginzburg-Landau model of the superconductivity near (Tc). Resistive measurements of the characteristic sin(sup 2)(theta) angular dependence associated with flux motion models show that only a fraction of the dissipation in the superconducting state is due to Lorentz force effects. DOE

N90-24919# Argonne National Lab., IL. Materials Science Div.
SPUTTERED SUPERCONDUCTING FILMS OF Bi2Sr2CaCu2O(x) MADE BY LOW-TEMPERATURE, IN-SITU GROWTH
R. T. Kampwirth, K. E. Gray, P. H. Andersen, D. B. McDonald, and D. J. Miller 1989 9 p Presented at the 36th American Vacuum Society National Vacuum Symposium, Boston, MA, 23-27 Oct. 1989 Submitted for publication
(Contract W-31-109-eng-38; NSF STC-88-09854)
(DE90-010092; CONF-891093-28) Avail: NTIS HC A02/MF A01

Composite target RF magnetron sputtering has previously been successfully employed to make superconducting films of YBa2Cu3O(7 minus x) in-situ at substrate temperatures T sub s less than 700 C. We report the successful growth of superconducting films of Bi2Sr2CaCu2O(sub x) on single crystal MgO substrates by a low-temperature process using dc magnetron sputtering from a Bi-enriched composite target. Using a substrate temperature T sub s approx. 645 C, metallic films with a superconducting onset of 90 to 100K and an extrapolated T sub c0 = 56K have been obtained. X ray diffraction shows the films to be c-axis oriented. Electron microscopy reveals that the films are not significantly smoother than films which were post-annealed at 865 C, and that some segregation into nonsuperconducting phases had occurred. The exact mechanism by which crystallization and superconductivity occurs at such low temperatures is not yet known, but it can be speculated that the surface atoms are less constrained and thus have a smaller energy barrier to overcome in forming a crystal structure. DOE

N90-24920# Argonne National Lab., IL. Materials Science Div.
THE DEFECT STRUCTURE OF ION AND NEUTRON IRRADIATED YBa2Cu3O(7-DELTA) SINGLE CRYSTALS
M. C. Frischherz, M. A. Kirk, J. Z. Liu, J. P. Zhang, and H. W. Weber (Atominstitut der Oesterreichischen Hochschulen, Vienna.) 1990 16 p Presented at the 15th Symposium on Effects of Radiation on Materials, Nashville, TN, 17-21 Jun. 1990
(Contract W-31-109-eng-38; NSF STC-88-09854)
(DE90-010100; CONF-900623-4) Avail: NTIS HC A03/MF A01

Using transmission electron microscopy techniques, we have begun a program to study cascade defects in the high-(Tc) superconductor YBa2Cu3O(7-delta). In-situ ion irradiations in the High Voltage Electron Microscope (HVEM)-Accelerator Facility at Argonne National Laboratory were performed to simulate low dose neutron irradiation at both room temperature and 40 K. Diffraction contrast experiments performed in two-beam dark field conditions in different operating reflections indicated defect cascades with hydrostatic pressure-like strain fields. Visible cascade defect yields ranged from 0.3 minus 1.0, depending on incident ion mass. High resolution micrographs revealed that at least some of these cascades have recrystallized regions that have rotated with respect to the surrounding lattice. Samples which were neutron irradiated to doses sufficient to produce overlapped cascades show a cellular structure of good crystalline material surrounded by highly defective or amorphous cell walls. It is suggested that the recrystallization observed in isolated cascade defects produced by low dose ion irradiation provides the mechanism for the formation of the cellular structure at high damage levels. Correlation of microstructure with magnetic measurements of critical current density increased by neutron irradiation and electrical resistivity measurements of the superconducting to insulating transition under ion irradiation are suggested. DOE

N90-24921# Argonne National Lab., IL. Chemistry and Materials Science Div.
VALENCE-DEFECT CHEMICAL EQUILIBRIA IN NONSTOICHIOMETRIC YBa2Cu3O(7-DELTA)
K. D. Carlson, L. R. Morss, and R. J. Thorn 1989 5 p Presented at the International Chemical Congress of Pacific Basin Societies, Honolulu, HI, 17-22 Dec. 1989
(Contract W-31-109-eng-38)
(DE90-010152; CONF-891206-11) Avail: NTIS HC A01/MF A01

Through models which are essentially nearest-neighbor lattice statistics, one can describe quantitatively the variation of the partial pressure of oxygen with temperature and composition of YBa2Cu3O(7-delta). One can predict the role of localized thermodynamic equilibrium in the transport of electrical charge. DOE

N90-24922# Argonne National Lab., IL. Dept. of Materials Science and Engineering.
DEPOSITION OF ELECTROOPTIC THIN FILMS
Angus I. Kingon, Shang-Hsien Rou, Michael S. Ameen, Thomas M. Graettinger, Kenneth Gifford, Orlando H. Auciello (North Carolina State Univ., Raleigh.), and Alan R. Krauss 1989 18 p Presented at the 91st Annual Meeting of the American Ceramic Society, Indianapolis, IN, 23-27 Apr. 1989 Sponsored in part by DARPA and NSF
(Contracts W-31-109-eng-38; N00014-88-K-0526)
(DE90-010543; CONF-890421-14) Avail: NTIS HC A03/MF A01

KNbO3 thin films have been deposited on Si and MgO (100) substrates by a new ion beam sputter deposition system. It was shown that, by choice of substrate and conditions, a variety of microstructures can be controllably achieved, varying from polycrystalline to epitaxial single crystal. In the case of the latter, two defect types were observed, viz antiphase domains and 211-type growth twins. A structure was postulated for the domain boundaries of the former. The relationships between microstructures and ferroelectric properties can now be investigated. Preliminary dielectric property measurements were made of polycrystalline films deposited on TiN/MgO (100) substrates. In the case of epitaxial KNbO3 films on MgO substrates, light was coupled into the films, and the films show low scattering losses. DOE

N90-24923# Argonne National Lab., IL. Chemistry Div.
COMPUTER-CONTROLLED ION BEAM SPUTTER DEPOSITION OF MULTICOMPONENT OXIDES
Angus I. Kingon, Orlando H. Auciello, Michael S. Ameen, Clifford N. Soble, Thomas M. Graettinger, Shang Hsien Rou (North Carolina State Univ., Raleigh.), and Alan R. Krauss 1989 11 p Presented at the 91st Annual Meeting of the American Ceramic Society, Indianapolis, IN, 23-27 Apr. 1989 Sponsored by DARPA; NSF; and ONR

(Contract W-31-109-eng-38)
(DE90-010544; CONF-890421-13) Avail: NTIS HC A03/MF A01

Multicomponent oxide thin films are of increasing technological importance for integrated optics and for devices containing ferroelectric memories and superconducting sensors and Josephson junctions. Methods for fabricating these thin films within particular process constraints are briefly reviewed. A new method of computer-controlled ion beam sputter deposition is described. The method is applied to electrooptic KNbO3 and superconducting YBa2 Cu3 A sub 7-delta thin films. DOE

N90-24924# Los Alamos National Lab., NM. Center for Materials Science.
HREM DEFECTS IN GaAs/Ga(1-x)In(x)As STRAINED LAYER SUPERLATTICES
O. Unal, B. K. Laurich, and T. E. Mitchell 1990 5 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract W-7405-eng-36)
(DE90-010610; LA-UR-90-1373; CONF-900466-23) Avail: NTIS HC A01/MF A01

GaAs/Ga(1-x)In(x)As strained layer superlattices with well-widths of 7nm, barrier widths of 14nm and periods of 10 to 30 were examined by HREM both in plan view and cross section. Strain release occurs mostly by dislocation generation but twins are also observed, especially at the substrate interface. High resolution images of dislocations, twins and interfaces are analyzed to elucidate mechanisms of strain release. DOE

N90-24925# Los Alamos National Lab., NM. Center for Materials Science.
PHASE STABILITY IN THE Al(6-x)Cu(x)Zr2 SYSTEM FOR 0 LESS THAN x LESS THAN 1.0
P. B. Desch, Ricardo B. Schwarz, and Philip Nash (Illinois Inst. of Tech., Chicago.) 1990 7 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract W-7405-eng-36)
(DE90-010620; LA-UR-90-1439; CONF-900466-21) Avail: NTIS HC A02/MF A01

The structures and thermal stability were determined for Al(6-x)Cu(x)Zr2 (0 is less than x is less than 1) powders prepared by mechanically alloying elemental powder mixtures. In the as mechanically alloyed condition the structure is LI(sub 2) for all x. After heating to 750 C the alloy is single phase DO23 for 0 is less than x is less than 0.6, and remains in the LI(sub 2) phase for 0.6 is less than x is less than 1. Al5CuZr2 is stable in the LI(sub 2) structure up to 1300 C. The lattice parameter of the annealed LI(sub 2) phase is independent of x. DOE

N90-24926# Midwest Research Inst., Golden, CO.
CONFERENCE ON THE SCIENCE AND TECHNOLOGY OF THIN-FILM SUPERCONDUCTORS Abstract Only
1990 196 p Conference held in Golden, CO, 30 Apr. - 4 May 1990
(Contract DE-AC02-83CH-10093)
(DE90-000326; SERI/TP-210-3723; CONF-900432-Absts) Avail: NTIS HC A09/MF A02

This document contains abstracts from papers presented at the Conference on Science and Technology of Thin-Film Superconductors. Among the topics covered are: Conditions for the In Situ Formation of Yoco Films, High (Tc) Superconducting Layered Structures and Superlattices, Characterization and Applications of Superconducting Thin Films, and Fabrication and Growth of Superconducting Thin Films. DOE

N90-24927# Argonne National Lab., IL. Materials Science Div.
CATION AND ANION TRACER DIFFUSION IN YBa(SUB 2)Cu(SUB 3)O(SUB 7-DELTA)
J. L. Routbort, N. Chen, Kenneth C. Goretta, and S. J. Rothman Mar. 1990 12 p Presented at the ICMC 1990 Topical Conference on High Temperature Superconductors: Materials Aspects, Garmisch-Partenkirchen, Fed. Republic of Germany, 9-11 May 1990
(Contract W-31-109-eng-38)
(DE90-009708; CONF-900527-1) Avail: NTIS HC A03/MF A01

Sintering, grain growth, deformation and oxygenation are examples of diffusion controlled processes which are important in the fabrication of high-temperature superconductors. It is well known, for example, that YBa(sub 2)Cu(sub 3)O(sub 7-delta) (123) requires oxygenation after sintering to achieve a nearly stoichiometric compound with the maximum possible superconducting transition temperature, T(sub C). Ceramic processing usually involves competition between such processes as grain growth and sintering. In general, there exists an ideal microstructure to maximize performance. However, because of the competition between the various kinetically controlled processes, the ideal microstructure cannot be easily achieved; one can, nevertheless, hope to optimize the microstructure if one has a detailed knowledge of the kinetics which control these processes. A knowledge of the diffusion coefficients, used in conjunction with processing for optimal microstructures, can lead to significant improvements in electrical properties and mechanical reliability. For these reasons, a comprehensive investigation of anion and cation diffusion in 123 has been undertaken. All oxygen ion diffusion measurements were carried out on samples which had been well equilibrated in order to eliminate any channel potential gradient so that the diffusion measurements yielded tracer and not chemical diffusion coefficients. Chemical diffusion of oxygen controls the oxygenation of 123 after sintering and its importance cannot be ignored. However, while the chemical and the tracer diffusivity are related, the proportionality factor is not well known and the tracer diffusivity, D, is likely to yield more meaningful fundamental information. In this paper, the results of oxygen tracer diffusion in both poly- and single crystalline 123 will be presented. DOE

N90-24928# Argonne National Lab., IL. Chemistry Div.
THE USE OF CURIUM AS A RARE EARTH SUBSTITUTE IN HIGH T(SUB c)-RELATED COMPOUNDS
L. Soderholm, C. W. Williams, and U. Welp 1989 5 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989
(Contract W-31-109-eng-38)
(DE90-009724; CONF-891119-131) Avail: NTIS HC A01/MF A01

The synthesis of Cm(sub 2)CuO(sub 4) was reported.The lattice constants of this material, determined by x ray diffraction, show it to be a new member of the isostructural series R(sub 2)CuO(sub 4) (R(equals)Pr, Nd, Sm, Eu, and Gd). Analysis of magnetic measurements is consistent with a free-ion effective moment for Cm(sup 3+), with no contribution to the susceptibility from Cu-ions. DOE

N90-24929# Sandia National Labs., Albuquerque, NM.
TIN DOPING OF InSb GROWN BY MOCVD USING TETRAETHYLTIN
R. M. Biefeld 1990 9 p Presented at the Spring Meeting of the Electrochemical Society, Montreal, Quebec, 6-11 May 1990
(Contract DE-AC04-76DP-00789)
(DE90-009727; SAND-90-0256C; CONF-900562-3) Avail: NTIS HC A02/MF A01

Tetraethyltin was investigated as an n-type dopant for InSb. Carrier concentrations between 6 (times) 10(sup 15) and 4 (times) 10(sup 18) cm(sup (minus)3) with 77 K mobilities ranging from 75,000 to 10,000 cm(sup 2)/Vs were achieved for Sn doped InSb. SIMS measurements indicate a diffusion coefficient for Sn in InSb at 470 C that is approximately 1(times)10(sup (minus)15) cm(sup 2)/s. Both Hall and SIMS measurements on Sn doped samples indicate that Sn in incorporated as an n-type dopant with no memory effect and no self compensation, making Sn a much better doping source than Te or Se. DOE

N90-24930# Oak Ridge National Lab., TN.
THERMAL AND PHASE ANALYSIS OF YBa2Cu3O(7-x) POWDER COMPACTS WITH ORGANIC ACID ADDITIVES

Mark V. Parish, James D. Hodge (CPS Superconductors, Inc., Milford, MA.), and Camden R. Hubbard 1990 7 p Presented at the 3rd International Conference on Ceramic Powder Processing Science, San Diego, CA, 4-7 Feb. 1990
(Contracts DE-AC05-84OR-21400; N00014-88-C-0512)
(DE90-010142; CONF-900218-2) Avail: NTIS HC A02/MF A01

Simultaneous DTA/TGA and x ray diffraction patterns were used to examine the burnout behavior of orthorhombic and tetragonal YBa2Cu3O(7-x) powders with small amounts of organic additives in three different atmospheres. It was found that small amounts of organic materials containing carboxylic acids can decrease the phase purity of YBa(c)Cu3O(7-x) at temperatures as low as 200 C. Generally, the organic material burns off at lower temperatures for the tetragonal powder compacts than for the orthorhombic compacts. Stronger organic acids burn-off at somewhat higher temperatures than weaker ones. Organic additive removal is still possible in an inert atmosphere (argon), but will degrade the YBa2Cu3O(7-x) into more simple oxide components; tetragonal powder mixtures are more sensitive to this damage than are orthorhombic powder mixtures. DOE

N90-24931# Argonne National Lab., IL. Materials and Components Technology Div.
USE OF NEUTRON DIFFRACTION IN DETERMINING STRAINS IN HIGH-TEMPERATURE SUPERCONDUCTING COMPOSITES
D. S. Kupperman, J. P. Singh, S. Majumdar, R. L. Hitterman, and J. Faber, Jr. (Amoco Oil Co., Naperville, IL.) Nov. 1989 8 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989 Submitted for publication
(Contract W-31-109-eng-38)
(DE90-010404; CONF-891119-128) Avail: NTIS HC A02/MF A01

The Argonne Intense Pulsed Neutron Source and General Purpose Powder Diffractometer have been used to study high (Tc) metal oxide composites composed of yttrium barium copper oxide and silver. Neutron diffraction techniques were applied to composites with 15, 20 and 30 percent silver content by volume. We have observed that after hot pressing, the 30 percent Ag specimens contained both orthorhombic high (Tc) and tetragonal, non-superconducting phases near the center of the specimens but only tetragonal near the surface. The relationship of shift in Bragg peaks to strains of the constituents is discussed. DOE

N90-24932# Argonne National Lab., IL. Materials and Components Technology Div.
RF SURFACE RESISTANCE MEASUREMENTS IN THE Pb-Bi-Sr-Ca-Cu-O SYSTEM
M. T. Lanagan, C. T. Bohn, J. R. Delayen, M. C. Einloth, R. N. Vogt, and U. Balachandran Nov. 1989 6 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989
(Contract W-31-109-eng-38)
(DE90-010412; CONF-891119-127) Avail: NTIS HC A02/MF A01

Wires were fabricated from the high-Tc superconductor Bi sub 0. 7 Pb sub 0.3 SrCaCu sub 1.8 O sub delta (Pb-BSCCO) by an extrusion process. The specimens were sintered at times up to 14 days, and density was found to decrease for longer sintering times. Rf surface resistance data revealed that the onset of superconductivity occurred at 105K and that the transition was very broad. DOE

N90-24933# Argonne National Lab., IL. Materials and Components Technology Div.
SYNTHESIS OF CERAMIC SUPERCONDUCTORS UNDER LOW OXYGEN PRESSURE
U. Balachandran, Roger B. Poeppel, J. E. Emerson, M. T. Lanagan, C. A. Youngdahl, and S. A. Johnson Dec. 1989 9 p Presented at the International Conference on Superconductivity, Bangalore, India, 10-14 Jan. 1990 Submitted for publication
(Contract W-31-109-eng-38)
(DE90-010415; CONF-900133-2) Avail: NTIS HC A02/MF A01

We have developed a process for synthesizing orthorhombic YBa2 Cu3 O sub x (123) superconducting powders, which involves calcination of the precursor powder under reduced total oxygen pressure. Because a single calcination at 800 C for 4 h in flowing oxygen with a pressure of 2 mm Hg results in essentially phase-pure material, total calcination times have been drastically reduced. At liquid nitrogen temperature, sintered pellets made from this powder have critical current densities of approximately 1000 A/sq cm in zero applied magnetic field. DOE

N90-24934# Argonne National Lab., IL. Materials and Components Technology Div.
THE EFFECT OF MAGNETIC FIELD ON THE CRITICAL CURRENT DENSITY OF BULK SUPERCONDUCTING WIRES
M. T. Lanagan, U. Balachandran, C. A. Youngdahl, J. T. Dusek, J. J. Picciolo, and Roger B. Poeppel Nov. 1989 9 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989
(Contract W-31-109-eng-38)
(DE90-010458; CONF-891119-126) Avail: NTIS HC A02/MF A01

Bulk YBa2 Cu3 O7-x (YBCO) wires and tubes were fabricated by a conventional extrusion technique and sintered above 900 C. The critical current density (Jc) was measured as a function of applied magnetic field at 77 K, and was found to decrease significantly at fields below 100 G. A manifestation of the magnetic field dependence of Jc is the correlation between critical current density and specimen geometry. In addition, when a concentric magnetic field was generated by passing a current though a copper wire, the external field from the wire could constructively or destructively interfere with the magnetic field produced by current in the YBCO tube. Jc was found to increase by 10 percent when the current in the YBCO tube was opposite to the current in the copper wire. The large change in electrical properties with magnetic field has been attributed to weak link behavior at the grain boundaries. Batch to batch differences in the field dependence of Jc imply the possibility of reducing the dependence by processing modifications. DOE

N90-24935# Argonne National Lab., IL. Materials Science Div.
REAL SPACE METHOD OF POWDER DIFFRACTION FOR NON-PERIODIC AND NEARLY PERIODIC MATERIALS
T. Egami, B. H. Toby, W. Dmowski, and Chr. Janot (Institut Laue-Langevin, Grenoble, France) Dec. 1989 7 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989
(Contract W-31-109-eng-38; NSF DMR-86-17950; NSF STC-88-09854)
(DE90-010537; CONF-891119-130) Avail: NTIS HC A02/MF A01

The use of high-energy neutrons from pulsed or hot sources allows the method of atomic pair distribution analysis to be applied to the structural determination of crystalline as well as amorphous solids. This method complements the standard crystallographic methods in studying non-periodic aspects of solids with or without long range order. DOE

N90-24936# Argonne National Lab., IL. Chemistry Div.
STUDIES ON ION SCATTERING AND SPUTTERING PROCESSES IN ION BEAM SPUTTER-DEPOSITION OF HIGH Tc SUPERCONDUCTING FILMS: THE OPTIMIZATION OF DEPOSITION PARAMETERS
Michael S. Ameen, Orlando H. Auciello, Angus I. Kingon, Alan R. Krauss, and M. A. Ray (Microelectronics Center of North Carolina, Research Triangle Park.) 1989 8 p Presented at the 36th American Vacuum Society National Vacuum Symposium, Boston, MA, 23-27 Oct. 1989
(Contracts W-31-109-eng-38; DE-FG05-88ER-45359; N00014-88-K-0525; N00014-88-K-0526; NSF DMR-88-07367)
(DE90-010538; CONF-891093-29) Avail: NTIS HC A02/MF A01

Ion beam sputter-deposition is one of the techniques used for synthesizing high (Tc) superconducting films in laboratory experiments. However, the scaling-up of this method for

technological applications, such as in microelectronics, will require a better understanding of basic phenomena occurring during the deposition process. First results are presented here from experimental and computer simulation studies on ion scattering and sputtering processes. It is demonstrated that scattering of neutralized ions from the targets can result in undesirable erosion of, and inert gas incorporation in, the growing films, depending on the ion/target atom mass ratio and ion beam angle of incidence/target/substrate geometry. The studies indicate that sputtering by Kr(+) or Xe(+) ions is preferable to the most commonly used Ar(+) ions, since the undesirable phenomena mentioned above are minimized for the first two ions. These results are used to determine optimum sputter deposition geometry and ion beam parameters for growing high (Tc) films. DOE

N90-24937# Syracuse Univ., NY.
THE CATALYTIC REACTIVITY OF THIN FILM CRYSTAL SURFACES Final Technical Report, 1 Jul. 1984 - 31 Dec. 1989
Richard W. Vook 1 Mar. 1990 15 p
(Contract DE-FG02-84ER-45139)
(DE90-010579; DOE/ER-45139/5) Avail: NTIS HC A03/MF A01

A detailed investigation of the surface reactivity of epitaxial Pd(111) and Cu(111)/Pd(111) thin films was carried out for the CO oxidation reaction to form CO2. The work involved AES, LEED, WF, TDS, isothermal desorption spectroscopy, TEM/TED, and high pressure catalytic reactivity investigations. Significant results were obtained regarding: (1) the thin film growth modes and the morphology of the overlayers, (2) the isothermal desorption energy of CO from Pd(111) films, (3) CO desorption energies form Pd(111) and Cu(111)/Pd(111) bilayer films, (4) the kinetics of CO and O2 adsorption on Pd(111) films and for CO on various Cu(111)/Pd(111) thin film bilayers, and (5) the relative CO oxidation rates on Pd(111) and various Cu(111)/Pd(111) bilayer films in the one atmosphere pressure range. The catalysis results were interpreted in terms of weakly adsorbed CO and O2 molecules and the formation of surface steps when the Cu overlayer thickness exceeded the critical thickness for misfit dislocation formation. These results are important in understanding the nature of the catalytic CO oxidation reaction using thin metal overlayers. It is the first such study of this reaction using metal bilayers, both of which were epitaxial thin films. DOE

N90-24938# Lawrence Livermore National Lab., CA.
SiC FILM DEPOSITED BY PULSED EXCIMER LASER ABLATION
R. J. Tench, M. Balooch, A. L. Connor, L. Bernardez, B. Olson, M. J. Allen, W. J. Siekhaus, and D. R. Olander (California Univ., Berkeley.) 19 Apr. 1990 7 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 15-20 Apr. 1990 Submitted for publication
(Contract W-7405-eng-48; NSF CBT-89-1240)
(DE90-010634; UCRL-JC-103614; CONF-900466-25) Avail: NTIS HC A02/MF A01

Thin films of (Beta) - SiC were grown on Si substrates by excimer laser pulse ablation of bulk SiC. The films were examined by Auger electron, x ray, and photoelectron spectroscopies. The film was smooth as monitored by scanning electron microscopy. Scanning electron and scanning tunneling microscopy showed inclusions in the deposited SiC film and laser ionization mass analysis detected SiC dimers in the vapor plume emitted from the target. DOE

N90-24939# Research Inst. of National Defence, Linkoeping (Sweden). Dept. of Information Technology.
PREPARATION OF HIGH Tc SUPERCONDUCTING CERAMIC MATERIALS OF THE Y-Ba-Cu-OXIDE TYPE
Lars-David Wernlund and Goesta Hermansson Nov. 1989 15 p In SWEDISH; ENGLISH summary
(FOA-C-30550-3.2; ISSN-0347-3708; ETN-90-96588) Avail: NTIS HC A03/MF A01; Research Inst. of National Defence, Box 1165, S-581 11 Linkoeping, Sweden, 50 Swedish crowns

Details of the preparation of yttrium-barium-copper oxides samples, with superconducting transition temperature well above the boiling point of nitrogen, are reported. Polycrystalline disks with high density are prepared for use as sputtering targets or as test samples to analyze electromagnetic shielding effects at low frequencies. The objective was to produce disks of a maximum compactness (more than 90 percent of the theoretical value is considered as a good achievement). Optimal pressure for this material is about 5 tons per sq cm. ESA

N90-24940# Technische Univ., Eindhoven (Netherlands).
ENSEMBLE MONTE CARLO SIMULATION OF ELECTRON TRANSPORT IN AlGaAs/GaAs HETEROSTRUCTURES Ph.D. Thesis
Karel Nederveen 1989 189 p
(ISBN-90-9003048-4; ETN-90-96895) Avail: NTIS HC A09/MF A01

In this modeling method the Boltzmann transport equation is solved with statistical techniques, from the knowledge of the electric field and the rates of different possible interactions of an electron with the semiconductor lattice. Principles of the Monte Carlo technique are outlined and the scatter processes accounted for in the semiconductors are discussed. The computer program developed is tested by simulations of bulk GaAs. The electron transport along the AlGaAs/GaAs interface is studied. Poisson's equation is solved in one dimension, providing the transverse electric field in a self consistent manner. An ensemble Monte Carlo model is presented for the High Electron Mobility Transistor (HEMT), in which Poisson's equation is solved in two dimensions. A transition process, called quantum well transfer, using Fermi's golden rule, is described. ESA

N90-24941# Newcastle-upon-Tyne Univ. (England). Dept. of Physics.
MICROSCOPIC THEORY OF NON-LINEAR PHENOMENA IN SEMICONDUCTOR SUPERLATTICES Final Report, 1 Jan. 1988 - 31 Dec. 1989
M. Jaros Apr. 1990 13 p Sponsored in part by Ministry of Defence; Royal Signals and Radar Establishment, Malvern, England; and ESPRIT
(Contract N00014-88-J-1003)
(AD-A221106) Avail: NTIS HC A03/MF A01 CSCL 20/12

The research on Si-Ge superlattices has: (1) refuted the explanation of optical spectra, (2) provided the first clear cut argument that shows the importance of defects and interface roughness in interpreting experimental data; this is now an accepted status quo, and (3) demonstrated the first quantitative study on finite superlattices. A quantitative study of the role of non-ideal interfaces (i.e., those where the two dimensional translations symmetry in the interface plane is not fully preserved) is presented. Demonstrated is the possibility to study real geometry structures under strong external fields. Presented is a fresh picture of the valley mixing which occurs when states of different bulk momenta cross, for example in GaAsAlAs structures under hydrostatic pressure or under the influence of a strong external electric field. The picture based on particle in a box perturbative models fails to represent correctly even the symmetry related features predicted in our theory and seen in experiments. GRA

N90-24942# Wisconsin Univ., Milwaukee.
ELECTROMIGRATION IN METALLIC MICROSTRUCTURES Final Technical Report, Jun. 1985 - Mar. 1989
Richard S. Sorbello Mar. 1990 55 p
(Contract F30602-85-C-0071; AF Proj. 2306)
(AD-A221208; RADC-TR-90-15) Avail: NTIS HC A04/MF A01 CSCL 20/2

Theoretical studies of electromigration in metallic microstructures have been performed in atomic dynamics and electronic aspects of driving forces. A general formulation of electrical conductivity and electromigration in bulk systems, thin films, and other low-dimensional systems has been constructed. Electromigration driving forces can be calculated from consideration of elastic scattering, although it is the inelastic part of the electron scattering that propels the migrating atom. However, non-adiabatic

recoil effects play an important role in the atomic migration of light interstitials at lower temperatures. Model calculations for electromigration at grain boundaries, dislocations and surfaces show substantial variation in driving forces as an interface is approached. This variation is caused by the form of the current distribution near an interface and in multiple scattering resonances between an interface and the impurity. GRA

N90-24943# California Univ., Los Angeles. Dept. of Electrical Engineering.
LIGHT-MILLIMETER WAVE INTERACTIONS IN SEMICONDUCTOR DEVICES Final Report, 1 Jan. 1986 - 31 Mar. 1989
Harold R. Fetterman 30 Jan. 1990 132 p
(Contract F49620-86-K-0007)
(AD-A221214; AFOSR-90-0511TR) Avail: NTIS HC A07/MF A01 CSCL 09/3

The investigation focussed on the nature of optical-millimeter wave interactions in high frequency semiconductor devices. It relied primarily upon optical mixing between frequency locked lasers but also included picosecond studies with a number of different laser systems. Actual devices investigated ranged from FETs to high frequency HEMTs (High Electron Mobility Transistors) and HBTs (Heterojunction Bipolar Transistors.) The actual experiments ranged using optical techniques to obtain fundamental physical information about the nature of these devices at high frequencies to investigating optical control and new application areas. The devices range from special configurations developed at UCLA to advanced, submicron, GaAs alloy devices fabricated in local high technology research laboratories. GRA

N90-24944# Ceramphysics, Inc., Westerville, OH.
RESEARCH ON HIGH-SPECIFIC-HEAT DIELECTRICS Final Report, 1 Apr. 1986 - 31 Aug. 1989
W. N. Lawless 31 Jan. 1990 391 p
(Contract F49620-86-C-0049)
(AD-A221215; AFOSR-90-0502TR) Avail: NTIS HC A17/MF A03 CSCL 20/12

A large amount of experimentation has been performed on ceramic samples of zinc chromite and cadmium chromite prepared under new conditions of doping, stress, purity, and particle size. No structures in the specific heats of these spinels are induced above 15 K by wide variations in one or all of these conditions. Under various doping conditions, the specific heat peak in cadmium chromite can be sharpened, broadened, or eliminated, but not split. In contrast, the specific heat peak in zinc chromite is easily spit into two components by all dopants studied. Calorimetric, magnetic susceptibility, and EPR measurements are in basic agreement in characterizing these effects. GRA

N90-24945# General Electric Co., Schenectady, NY.
DEVELOPMENT OF ELEMENTS OF A HIGH Tc SUPERCONDUCTING CABLE Report, 1 Jan. - 31 Mar. 1990
Kenneth W. Lay 31 Mar. 1990 5 p
(Contract N00014-88-C-0681)
(AD-A221300) Avail: NTIS HC A01/MF A01 CSCL 13/8

The goal of the program is the development of materials and processes for the fabrication of a composite high Tc superconductor element made of a superconducting coating in a supporting fiber. GRA

N90-24946# Harry Diamond Labs., Adelphi, MD.
QUANTUM-CONFINED HOLE STATES IN DOUBLE-BARRIER RESONANT TUNNELING STRUCTURES
John D. Bruno and Richard L. Tober May 1990 9 p
(AD-A221342; HDL-TL-90-4) Avail: NTIS HC A02/MF A01 CSCL 20/10

Double-barrier resonant tunneling structures often contain undoped spacer layers separating heavily n-doped regions from active regions of the structure. Conduction band electrons coming from the heavily doped regions diffuse into the undoped regions, producing potential energy profiles that can confine hole states within the spacer layers. A classical model is used to predict the potential energy profiles in these structures, and the associated hole binding energies and wave functions are calculated numerically. GRA

N90-24947# Litton Systems, Inc., Charlotte, NC. Airtron Div.
CONTRACT CRYSTAL GROWTH AND FABRICATION SERVICES Quarterly Technical Report No. 4, Feb. - Apr. 1990
J. E. Creamer, R. C. Acklin, and M. H. Randles 1 May 1990 3 p
(Contract N00014-89-C-2222)
(AD-A221357) Avail: NTIS HC A01/MF A01 CSCL 20/2

This program is intended to give the scientists at the Naval Research Laboratory the ability to evaluate new solid state laser crystals. The crystal requested and grown was Cr,Tm:YALO. The melt composition is listed. It was assumed that the distribution coefficients are unity and that the crystal composition will be the same as the melt. The crystal was grown with a b-axis YALO seed. At about the time full diameter was reached, the crystal developed twins, apparently from several pieces of iridium that attached to the surface at that point. The oxygen level can be adjusted on future runs to decrease the occurrence of iridium metal. As a result of the twinning some of the crystal was badly cracked, but a 63.5mm laser rod was extracted. GRA

N90-24948# Diamond Materials, Inc., State College, PA.
SYNTHESIS OF LARGE AREA, MONOCRYSTALLINE TiC AS A SUBSTRATE FOR HETEROEPITAXIAL GROWTH OF BETA-SiC Technical Report, 7 Sep. 1989 - 7 May 1990
Richard Koba and Donald Kupp 7 May 1990 19 p
(Contract N00014-89-C-0208)
(AD-A221392; TR-90004) Avail: NTIS HC A03/MF A01 CSCL 20/12

DMI has finished de-bugging its upgraded Beta-SiC CVD reactor. Experiments were performed to determine the optimal etching treatment for silicon substrates to prepare them for Beta-SiC CVD. Etching experiments using pure Hydrogen and 1 to 5 percent Hydrogen Chloride/Hydrogen indicated that mild etching of the silicon surface only served to decorate crystallographic defects left behind by the chem-mechanical polishing of the Si wafer. A vigorous etch by 5 percent HCl/H2 at 1300 C for 10 minutes was sufficient to remove several microns of the silicon, exposing a reasonably flat and smooth Si surface suitable for Beta-SiC heteroepitaxial growth. DMI believes it has grown heteroepitaxial Beta-SiC on Si from 1.9 precent methyltrichlorosilane (MTS) diluted in H2 at 1300 to 1400 C for five minutes. To finish the program, DMI will work to grow an approx. 30 microns thick, freestanding Beta-SiC single crystal and will perform a chlorinated oxidation on the Beta-SiC to getter crystallographic defects from its surface. Titanium Carbide will be then be deposited onto the Beta-SiC single crystal by CVD. The SBIR program directly supports DoD efforts to develop monocrystalline Beta-SiC as a semiconductor material. GRA

N90-24949# Technische Univ., Berlin (Germany, F.R.). Fachbereich fuer Elektotechnik.
ANALYSIS AND REALIZATION OF INTEGRATED OPTICAL POLARIZERS AND ABSORBERS ON LiNbO3 Ph.D. Thesis [ANALYSE UND REALISIERUNG INTEGRIERT-OPTISCHER POLARISATOREN UND ABSORBER AUF LINBO3]
Gerd Stock 1989 147 p In GERMAN Sponsored by DFG
(ETN-90-96504) Avail: NTIS HC A07/MF A01

Multilayer polarizers with metal superior layer are theoretically analyzed and modelized and technically examined by calculator simulation. By means of the scalar wave equation a recursion instruction is given to obtain the characteristic equation of a multilayer model, and the profile of the eigen functions are depicted by computer programs. The polarization-depending softening properties of metal layer wave guides were shown. Tests were carried out with wave guides of varied width, made by diffusion of titanium on a LiNbO3 substrate and with MgO as buffer material. ESA

N90-24950# Sandia National Labs., Albuquerque, NM.
PREDICTING SWITCHED-BIAS RESPONSE FROM STEADY-STATE IRRADIATIONS
D. M. Fleetwood 1990 4 p Presented at the 27th IEEE Annual International Nuclear and Space Radiation Effects Conference, Reno, NV, 16-20 Jul. 1990
(Contract DE-AC04-76DP-00789)
(DE90-006770; SAND-90-0161C; CONF-900723-2) Avail: NTIS HC A01/MF A01

In actual circuit application, MOS transistor bias is generally not constant through radiation exposure. Nevertheless, the overwhelming majority of radiation effects studies and hardness assurance testing is performed at constant bias for simplicity and practicality. In the past 15 years, however, it has been shown that oxide- and interface-trap charge buildup and annealing during switched-bias exposures can differ quantitatively and qualitatively from that observed during steady state exposures. This has made it difficult to develop predictive models of MOS circuit response for actual use conditions, and has introduced uncertainty into hardness assurance testing of MOS circuits. In this summary, defect growth and annealing rates are compared for steady-state and switched-biased irradiations of MOS transistors. A simple method is described to predict MOS oxide-trap charge, interface-trap charge, and mobility degradation during switched-bias exposures from steady state (on and off) irradiations. Over a wide range of switching conditions for the devices examined, this method has provided predictions typically accurate to within better than 20 percent. The maximum error observed to data is less than 40 percent. This method should allow the total-dose radiation response of MOS circuits in real-use scenarios to be modeled with improved accuracy and flexibility. DOE

N90-24951# Argonne National Lab., IL. Materials and Components Technology Div.
IMPROVED PROCESSING OF CERAMIC SUPERCONDUCTORS
Roger B. Poeppel, U. Balachandran, J. E. Emerson, S. A. Johnson, M. T. Lanagan, C. A. Youngdahl, and N. G. Eror (Pittsburgh Univ., PA.) Oct. 1989 16 p Presented at the 1st International Ceramic Science and Technology Congress, Anaheim, CA, 31 Oct. - 3 Nov. 1989 Submitted for publication
(Contract W-31-109-eng-38)
(DE90-009721; CONF-8910120-10) Avail: NTIS HC A03/MF A01

Vacuum calcination of precursor powder under controlled total oxygen pressure was investigated for synthesizing YBa2Cu3O(x) (YBCO) superconductor. The reaction temperature, approximately 800 C, is approximately 100 C lower than that used in ambient-pressure calcination. Since a single calcination results in essentially phase-pure material, total calcination times have been drastically reduced. The vacuum-calcined powder has finer particles and consequently greater sinterability than powders made by conventional methods. Samples made from this powder have critical current densities of approximately 1000 A/sq cm at 77 K in zero applied external magnetic field. DOE

N90-24952*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH-TEMPERATURE SUPERCONDUCTORS FOR SPACE POWER TRANSMISSION LINES
John R. Hull (Argonne National Lab., IL.) and Ira T. Myers Aug. 1989 24 p Presented at the ASME Winter Annual Meeting Conference, San Francisco, CA, 10-15 Dec. 1989
(Contract W-31-109-eng-38)
(NASA-TM-103459; NAS 1.15:103459; DE90-009725; CONF-891208-32) Avail: NTIS HC A03/MF A01 CSCL 20L

Analysis of high temperature superconductors (HTS) for space power transmission lines shows that they have the potential to provide low weight alternatives to conventional power distribution systems, especially for line lengths greater than 100 m. The use of directional radiators, combined with the natural vacuum of space, offers the possibility of reducing or eliminating the heat flux from the environment that dominates loss in terrestrial systems. This leads to scaling laws that favor flat conductor geometries. From a total launch weight viewpoint, HTS transmission lines appear superior, even with presently attainable values of current density. DOE

N90-24953# Los Alamos National Lab., NM.
TRANSVERSE- AND ZERO-FIELD MUON SR INVESTIGATION OF MAGNETISM AND SUPERCONDUCTIVITY IN (Y(1-x)Pr(x)Ba2Cu3O7)
D. Wayne Cooke, M. S. Jahan, R. S. Kwok, R. L. Lichti, T. R. Adams, C. Boekema, W. K. Dawson, A. Kebede, J. Schwegler, and J. Crow (Temple Univ., Philadelphia, PA.) 1990 7 p Presented at the 5th International Conference on Muon Spin Rotation, Relaxation and Resonance, Oxford, England, 9-12 Apr. 1990
(Contract W-7405-eng-36)
(DE90-010597; LA-UR-90-1313; CONF-900489-1) Avail: NTIS HC A02/MF A01

Zero-field muon-spin-rotation (muSR) measurements on (Y(1-x)Pr(x)Ba2Cu3O7 (x = 1.0, 0.8, 0.6, and 0.54) show evidence for antiferromagnetic ordering of the Cu moments within the Cu-O planes, with Neel temperatures 285, 220, 35, 30, and 20 K respectively. For x = 1.0 the local muon magnetic field is approximately 16 mT, but decreases to approximately 12 mT at 17 K, due to additional magnetic ordering. The zero-field data, in conjunction with transport data, allow construction of a complete diagram for this system. Transverse-field (1 kOe) muSR data for x = 0.2 (Tc = 75 K) show that the muon depolarization is determined primarily by the Cu nuclear moments for T is greater than Tc. Fitting the superconducting-state data to a BCS model yields an extrapolated zero-temperature magnetic penetration depth of 2170 A. DOE

N90-24954# Lawrence Livermore National Lab., CA.
DEVELOPMENT OF A LARGE SCALE Nd:YAG GROWTH PROCESS
E. W. ODell, D. J. Nelson, D. Narasimhan, R. C. Morris (Allied-Signal Corp., Morristown, NJ.), and J. E. Marion Jan. 1990 10 p Presented at the SPIE Optics, Electro-Optics and Laser Applications in Science and Engineering Conference and Exhibition, Los Angeles, CA, 15-19 Jan. 1990
(Contract W-7405-eng-48)
(DE90-010746; UCRL-102201; CONF-900140-25) Avail: NTIS HC A03/MF A01

Development of an automated steady-state process for Czochralski growth of flat interface Nd:YAG laser crystals is described. Steady-state is achieved through addition to the melt to maintain constant melt depth and composition. Interface flattening is accomplished through a controlled spin-up of crystal rotation during which characteristic changes in melt flow and crystal weight are observed. Combined steady-state/flat-interface growth has been demonstrated for sections up to 30 mm diameter x 110 mm long. In batch mode, without melt addition, flat interface YAG and Nd:YAG up to 52 x 220 mm, and undoped YAG up to 85 x 75 mm were grown. In batch mode, gradual reduction of rotation rate is required to maintain interface contour and cross-sectional shape of the crystal as the melt height decreases. DOE

N90-24955# Columbia Univ., New York, NY. School of Mines.
PROTONS AND LATTICE DEFECTS IN PEROVSKITE-RELATED OXIDES Progress Report, 1 Jul. 1989 - 30 Apr. 1990
A. S. Nowick 1990 19 p
(Contract DE-FG02-88ER-45341)
(DE90-010957; DOE/ER-45341/3) Avail: NTIS HC A03/MF A01

The recent work on this project has focused on two perovskite-structured materials: single crystalline KTaO3 doped with iron-group ions, and ceramic BaCeO3 doped with Nd, Gd, Sc and Ca. In the case of KTaO3, it is shown that protons are introduced into the crystal from H2O vapor so that it becomes primarily a protonic conductor. The defect reactions involved have been considered in detail with the aid of EPR and IR measurements. In the study of BaCeO3, it was found that the Nd-doped material is

an excellent protonic conductor with activation energy for proton hopping of only 0.54 eV. In addition, weight-change measurements were used to determine the amount of water uptake, while Nernst-cell measurements gave values for the transport numbers of oxygen and of protons. In contrast to the case of Nd doping, Gd or Yb-doped material are not protonic conductors. Other studies include those of high-(Tc) superconductors, the first showing a large elastic constant and internal friction anomaly in La(2x)Sr(x)CuO4, and the second showing under what conditions degradation occurs due to H2O and CO2 annealing treatments. Finally, a study of dielectric loss in Li-borate glasses shows that the dielectric loss peak in glasses widely believed to be due to a bulk phenomenon, is actually an electrode blocking effect. DOE

N90-24956# Sandia National Labs., Albuquerque, NM.
IMPROVING THE PERFORMANCE OF InAs(1-x)Sb(x)/InSb INFRARED DETECTORS GROWN BY METAL ORGANIC CHEMICAL VAPOR DEPOSITION
R. M. Biefeld and S. R. Kurtz 1990 12 p Presented at the 5th International Conference on Metalorganic Vapor Phase Epitaxy, Aachen, Federal Rep. of Germany, 18-21 Jun. 1990
(Contract DE-AC04-76DP-00789)
(DE90-009743; SAND-90-0088C; CONF-9006174-1) Avail: NTIS HC A03/MF A01

Diethylselenium and tetraethyltin were investigated as n-type dopants for InSb. Carrier concentrations between 6 x 10(exp 15) and 4 x 10(exp 18)/cu cm with 77 K mobilities ranging from 75,000 to 10,000 sq cm/Vs were achieved for Sn doped InSb. Triethylantimony and trimethylindium were used to grow InSb over the temperature range of 410 to 470 C with a decrease in the p-type background occurring at 410 C. Diodes were prepared using tetraethyltin, trimethylindium and trimethylantimony at 470 C. The resulting current-voltage characteristics are improved over those of diodes grown previously using dimethyltellurium. SIMS measurements indicate a diffusion coefficient for Sn in InSb at 470 C that is approx. 1 x 10(exp -15) sq cm/s. DOE

N90-24957# Argonne National Lab., IL. Materials and Components Technology Div.
PRACTICAL SUPERCONDUCTOR DEVELOPMENT FOR ELECTRICAL POWER APPLICATIONS
Roger B. Poeppel and Kenneth C. Goretta Sep. 1989 76 p
(Contract W-31-109-eng-38)
(DE90-010262; ANL-89/35) Avail: NTIS HC A05/MF A01

Development of useful high critical temperature (high-(Tc)) superconductors requires the synthesis of various superconducting oxide compounds; the fabrication of wires, tapes, and thin films from these compounds; the capability to form composite structures that incorporate integral insulators of stabilizers; and the design of efficient components and systems. The technical progress in and status of research efforts aimed at producing superconducting components based on the oxide systems YBCO, BSCCO, and TCBCO are described. Topics discussed are synthesis and heat treatment of high-(Tc) superconductors; formation of monolithic and composite wires and tapes; design and fabrication of superconductor/metal connections; characterization of microstructures and of superconducting, electrical, and mechanical properties; and fabrication and electrical properties of thin films. Interactions with industry and academia are also documented, and a list of selected program publications is provided. DOE

N90-24958# Sandia National Labs., Albuquerque, NM.
CHLORINE REACTIVE-ION-BEAM ETCHING OF InSb AND InAs0.15Sb0.85/InSb STRAINED-LAYER-SUPERLATTICES
G. Allen Vawter and Joel R. Wendt 1990 3 p Presented at the 32nd Electronic Materials Conference, Santa Barbara, CA, 27-29 Jun. 1990
(Contract DE-AC04-76DP-00789)
(DE90-010848; SAND-90-1177C; CONF-900654-1) Avail: NTIS HC A01/MF A01

It was demonstrated that Cl2 RIBE is a useful dry-etch technology for InSb and InAsSb/InSb Strained-Layer Superlattices (SLSs) in spite of the low vapor pressure of the In chlorides. Etching of these materials using both Cl2 Reactive-Ion-Beam Etching (RIBE) and Ar IBE resulted in extremely smooth surfaces and well controlled etch rates with Cl2 RIBE accelerating the etch rate by approximately a factor of two compared to Ar IBE over the range of beam energies studied. Sloped sidewalls resulted at all tested Cl2 RIBE energies and are probably caused by sidewall passivation with In chlorides. The anisotropy and reduced etch-induced damage of Cl2 RIBE is expected to become of critical importance in the fabrication of dense arrays of long-wavelength photodetectors. DOE

N90-24959# Sandia National Labs., Albuquerque, NM.
PRESSURE IN THE STUDY OF ORGANIC SUPERCONDUCTORS
J. E. Schirber, H. H. Wang, and J. M. Williams (Argonne National Lab., IL.) 1990 5 p Presented at the International Conference on Organic Superconductors, Lake Tahoe, CA, 20-24 May 1990
(Contracts DE-AC04-76DP-00789; W-31-104-eng-38)
(DE90-011049; SAND-90-1234C; CONF-900528-1) Avail: NTIS HC A01/MF A01

There is probably no area in materials science where pressure has had such a profound effect upon the field as in the study of organic superconductivity. The initial discovery of superconductivity at less than 1.6K in (TMTSF)2(PF6) by Jerome, Bechgaard and coworkers at high pressure initiated a world-wide activity that has resulted in the course of a decade in an increase in (Tc) from 1.6K to near 12K and identification of more than thirty organic superconductors. This near order of magnitude improvement in (Tc) has involved a number of breakthroughs in synthesis, in several cases aided by insights from pressure studies. Organic superconductors are typically very compressible and anisotropic materials compared to their inorganic counterparts. Since at low temperatures, all pressure media are solid, this has resulted in some controversy and disagreement among various investigators using different pressure generation techniques. Herein, the spectrum of materials which have been studied under purely hydrostatic conditions are reviewed and using single crystal materials because it is felt that this is the most valid way to make intercomparisons between the various families of these materials. DOE

N90-24960# Oak Ridge National Lab., TN. Metals and Ceramics Div.
Au-Ge-Ni-Ti OHMIC CONTACTS ON GALLIUM ARSENIDE
K. B. Alexander and W. M. Stobbs (Cambridge Univ., England) 1990 7 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract DE-AC05-84OR-21400)
(DE90-011064; CONF-900466-37) Avail: NTIS HC A02/MF A01

The influence of titanium additions on the microstructure of Au--Ge--Ni ohmic contacts on gallium arsenide was evaluated. Sequentially deposited layers of Ge, Au and Ni were topped with a titanium layer. The titanium formed a native titanium oxide on the upper surface of the contact which helped to maintain a continuous film during the anneal. Both the as-deposited and the annealed microstructures were studied with the use of electron microscopy techniques. In order to examine thoroughly the various phases which form in the annealed contact, unique specimen preparation procedures were used to fabricate a single plan-view specimen in which it was possible to examine the microstructure at various depths. DOE

N90-24961# Argonne National Lab., IL. Materials Science Div.
SUPERCONDUCTING THIN FILMS OF YBaCu OXIDES PREPARED BY MOCVD
G. R. Bai, Y. Gao, H. Shi, H. L. M. Chang, J. C. Parker, and D. J. Lam Apr. 1990 10 p Presented at the Symposium on High Temperature Superconductors of the 7th World Ceramic Congress, Trieste, Italy, 2-5 Jul. 1990
(Contract W-31-109-eng-38; NSF STC-88-09854)
(DE90-011109; CONF-900709-1) Avail: NTIS HC A02/MF A01

Thin films of Y--Ba--Cu--O system with Y:Ba:Cu ratio of 1:2:3

were prepared by MOCVD technique with a cold wall atmospheric/low pressure system. The film composition, crystallinity, morphology, and superconducting properties as a function of chemical precursor, gas pressure, flow rate, substrate materials and deposition temperatures are systematically studied. A variety of experimental tools are used to study the structure-property relationships. The effects of processing variables on the film morphology and superconducting properties are presented and discussed. DOE

N90-24962# Argonne National Lab., IL. Materials Science Div.
IN-SITU GROWTH OF SUPERCONDUCTING FILMS OF Bi-Sr-Ca-Cu-O USING MAGNETRON SPUTTERING
R. T. Kampwirth, J. M. Grace, D. J. Miller, D. B. McDonald, K. E. Gray, P. H. Andersen, B. Driehuys, M. Reiten, and M. Ascolese 1990 8 p Presented at the Science and Technology of Thin-Film Superconductors Conference, Golden, CO, 30 Apr. - 4 May 1990; sponsored by Midwest Research Inst.
(Contract W-31-109-eng-38; NSF STC-88-09854)
(DE90-011161; CONF-900432-1) Avail: NTIS HC A02/MF A01

Growing superconducting films of the high temperature superconductors (HTS) in a single step process within the vacuum system and at lower temperatures than post-annealed films has been the goal of many researchers. This has been achieved in YBa2Cu3O7 at a number of laboratories, but Bi and Tl-based HTS have proven more difficult. Superconducting films are reported of Bi2Sr2CaCu2O(x) and Bi2Sr2Ca2O(x) made by magnetron sputtering from a bismuth enriched composite target, onto MgO at substrate temperatures approx. 150 C lower than required for post-annealed films. These films show highly c-axis oriented growth without the need for epitaxy, which suggests that films might be grown on a variety of substrates both with and without a buffer layer. The exact mechanism of crystallization at such low temperatures is not yet known, but it can be speculated that the surface atoms are less constrained and thus have a smaller energy barrier to overcome in forming a crystal structure. There is a narrow temperature window for growth of the superconducting phase; at lower temperatures the films tend to be semiconducting, due probably to lack of sufficient thermal energy to crystallize a well-ordered phase. At higher temperatures the bismuth sticking coefficient decreases to the point where no bismuth remains and the films are insulating. DOE

N90-24963# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Sciences Div.
EFFECT OF Cu(2+) MAGNETIC MOMENTS ON THE SUPERCONDUCTIVITY OF YBa2Cu3O7: THE ORIGIN OF THE LINEAR TERM IN THE SPECIFIC HEAT; THE VOLUME FRACTION OF SUPERCONDUCTIVITY
Norman E. Phillips and R. A. Fisher (California Univ., Berkeley.) Apr. 1990 13 p Presented at the 25th Yamada Conference on Magnetic Phase Transitions, Osaka, Japan, 13-16 Apr. 1990 Submitted for publication
(Contract DE-AC03-76SF-00098)
(DE90-011214; LBL-28863; CONF-9004184-2) Avail: NTIS HC A03/MF A01

The concentration (n sub 2) of Cu(2+) magnetic moments located on the YBa2Cu3O7 lattice is determined by the specific heat in a 7-T magnetic field. The discontinuity in specific heat at (Tc) (Delta C(Tc)) and also the coefficient of the linear term (gamma (0)) are correlated with n(sub 2) in a way that suggests the operation of a pair-breaking mechanism that limits the transition to the superconducting states and provides a criterion for the volume fraction of superconductivity. Gamma(0) can be represented by the sum of two contributions, both associated with Cu(2+) moments, implying that there is no contribution that is an intrinsic property of the superconducting state. The interpretation of the data provides estimates of parameters relevant to the recognition of strong-coupling effects. DOE

N90-24964*# Sandia National Labs., Albuquerque, NM.
RAPID THERMAL PROCESSING OF HIGH TEMPERATURE SUPERCONDUCTING FIBER
J. W. Halloran, M. J. Neal, D. S. Ginley, E. L. Venturini, J. F. Kwak, R. J. Baughman, M. A. Mitchell, B. Morosin, S. N. Basu, and T. E. Mitchell (Los Alamos National Lab., NM.) 1990 7 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990 Sponsored in part by High Temperature Superconductor Pilot Center
(Contracts NAS3-25876; N00014-88-C-0512; DE-AC04-76DP-00789; W-7405-eng-36)
(NASA-CR-186803; NAS 1.26:186803; DE90-011236; SAND-90-1229C; CONF-900466-44) Avail: NTIS HC A02/MF A01 CSCL 20L

We report on the rapid thermal processing (RTP) of Y-123 fibers with and without presintering to form the orthorhombic phase. We show that fibers which were originally semiconducting and tetragonal before rapid thermal processing form normal twinned orthorhombic material after processing for 2 to 4 seconds at greater than 1000 C with a 3 min. cool down in oxygen. They subsequently show (Tc) to 90 K and magnetization indicative of substantial diamagnetic shielding. We present the effects of varying the RTP parameters on the morphology, phase, and superconducting properties of a number of tetragonal and orthorhombic Y-123 fibers. DOE

N90-24965# Oak Ridge National Lab., TN. Solid State Div.
ATOMIC SCALE IMAGING OF THE STRUCTURE AND CHEMISTRY OF SEMICONDUCTOR INTERFACES
S. J. Pennycook, D. E. Jesson, and M. F. Chisholm May 1990 13 p Presented at the SPIE's Symposium on Advances in Semiconductors and Superconductors: Physics Toward Device Applications, San Diego, CA, 17-21 Mar. 1990 Submitted for publication
(Contract DE-AC05-84OR-21400)
(DE90-011321; CONF-900302-1) Avail: NTIS HC A03/MF A01

A new technique for high-resolution electron microscopy is described together with a number of applications involving semiconductor interfaces. Optically this technique represents the realization of incoherent imaging at atomic resolution, with the advantages over conventional coherent imaging methods of improved resolution and an unambiguous, simply interpretable image. In addition, the image shows strong compositional sensitivity, thus providing a direct map of a material's structure and chemistry on the atomic scale. DOE

N90-24966# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Sciences Div.
LOW-TEMPERATURE SPECIFIC HEAT MEASUREMENTS ON METALS: APPLICATION TO HIGH-T(SUB c) SUPERCONDUCTORS
Norman E. Phillips and R. A. Fisher Mar. 1990 34 p Presented at the 119th Minerals, Metals and Metallurgical Society Annual Meeting and Exhibit, Anaheim, CA, 18-22 Feb. 1990 Prepared in cooperation with California Univ., Berkeley
(Contract DE-AC03-76SF-00098)
(DE90-011612; LBL-28751; CONF-900206-10) Avail: NTIS HC A03/MF A01

The main features of the specific heats of normal metals and conventional superconductors, and the types of information that can be derived from specific heat data are summarized. The complications in extending this approach to high-(Tc) superconductors are outlined. It is shown that the properties of the superconducting state in YBa2Cu3O7, and, more generally, probably in high-(Tc) materials, are correlated with a concentration of Cu(2+) magnetic moments that can be derived from specific heat data. These correlations are of both practical and fundamental interest. They provide a criterion that should be useful in evaluating processing techniques for the production of high-quality bulk superconductors, and the values of parameters that are relevant to the nature of the superconducting state. DOE

N90-24967# Pacific Northwest Lab., Richland, WA.
PREPARATION AND PROPERTIES OF SUPERCONDUCTING THIN FILMS BY EXCIMER LASER ABLATION
Michael E. Geusic, Alan F. Stewart, Larry R. Pederson, William J.

Weber, Kenneth R. Marken, and Kin Li (Boeing Co., Renton, WA.) Apr. 1990 7 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990 Submitted for publication
(Contract DE-AC06-76RL-01830)
(DE90-011929; PNL-SA-18024; CONF-900466-52) Avail: NTIS HC A02/MF A01

Excimer laser ablation with an in situ heat treatment was used to prepare high quality superconducting YBa2Cu3O(7-x) thin films on (100)-SrTiO3 and (100)-LaAlO3 substrates. A pulsed excimer laser (XeCl; 308 nm) was used to ablate a rotating, bulk YBa2Cu3O(7-x) target at a laser energy density of 2 to 3 J/sq cm. Based on four-probe dc resistance measurements, the films exhibited superconducting transition temperatures ((Tc), midpoint) of 88 and 87 K with 2 K (90 to 10 percent) transition widths for SrTiO3 and LaAlO3, respectively. Transport critical current densities (J sub c) measured at 77 K were 2 x 10(exp 6) and 1 x 10(exp 6) A/sq cm in zero field for SrTiO3 and LaAlO3, respectively. X ray diffraction (XRD) analysis showed the films to be highly oriented, with the c-axis perpendicular to the substrate surface. DOE

N90-24968# Los Alamos National Lab., NM.
MICROSTRUCTURE AND STABILITY OF TiB2 AND Cu MULTILAYERS
S. N. Basu, Kevin M. Hubbard, Juha-Pekka Hirvonen, T. E. Mitchell, and Michael Nastasi 1990 5 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990 Submitted for publication
(Contract W-7405-eng-36)
(DE90-011955; LA-UR-90-1518; CONF-900466-51) Avail: NTIS HC A01/MF A01

The interfacial stability of a high strength TiB2/Cu multilayer structure was examined by subjecting the layers to ion irradiation by 400 keV Ne(+ +) ions up to a maximum dose of 12 x 10(exp 15) ions/sq cm. Even at the highest dose, with maximum dpa value of 4.92, the explained by examining the maximum thermodynamic driving force for interfacial reactions in this system. DOE

N90-24969# Los Alamos National Lab., NM.
RF PROPERTIES OF HIGH TEMPERATURE SUPERCONDUCTORS: CAVITY METHODS
A. M. Portis (California Univ., Berkeley.), D. Wayne Cooke, and E. R. Gray 1990 20 p Presented at the Symposium on High Temperature Superconductors in High Frequency Fields, Williamsburg, VA, 28-30 Mar. 1990 Submitted for publication
(Contracts W-7405-eng-36; DE-AC03-76SF-00098)
(DE90-011961; LA-UR-90-1596; CONF-9003164-1) Avail: NTIS HC A03/MF A01

A description of cavities used in the study of the microwave properties of the high-temperature superconductors is followed by a lumped-circuit analysis of the coupling of transmission lines and resonators. The frequency dependence of the reflected and transmitted microwave power and the character of transient cavity response are analyzed. Techniques are discussed for the introduction of samples of the high-temperature superconductors into microwave cavities. Following a discussion of sample surface impedance and sample geometry factor, the connection between surface resistance and cavity Q is examined as well as the connection between cavity frequency shift and surface reactance. Measurement techniques that utilize reflected or transmitted power or transient response are described. DOE

N90-24970# Los Alamos National Lab., NM.
HIGHLY-TEXTURED THALLIUM-BARIUM-CALCIUM-COPPER-OXIDE POLYCRYSTALLINE SUPERCONDUCTING FILMS ON SILVER SUBSTRATES
Paul Arendt, Norman Elliott, D. Wayne Cooke, Robert Dye, Edward Gray, Kevin M. Hubbard, Joseph Martin, Gary Reeves, David Brown, and Albert Klapetzky 1990 11 p Presented at the Thin Film Superconducting Conference, Denver, CO, May 1990 Submitted for publication Sponsored in part by Strategic Defense Initiative Organization, Washington, DC
(Contract W-7405-eng-36)
(DE90-011972; LA-UR-90-1663; CONF-9005213-1) Avail: NTIS HC A03/MF A01

Thick (8 to 10 microns) Ba-Ca-Cu-O films were RF magnetron sputtered onto Ag alloy (Consil 995) substrates. The films were given a post-deposition anneal in an over pressure of Tl in order to form the superconducting phases. Annealing protocols were done which result in predominantly the 1212 and 2212 phases. The substrate orientation was varied to determine its effect on film orientation. Material properties of the films were characterized by x ray diffraction (XRD), ion beam backscattering spectroscopy, energy dispersive x ray analysis (EDAX), and scanning electron microscopy (SEM). Electrical characterization of the films was done using dynamic impedance (DI) at 10 kHz and RF surface resistance (R(sub s)) at 18 GHz in a TE(sub 011) fundamental mode cavity. DOE

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N90-24971# Technische Univ., Berlin (Germany, F.R.). Fachbereich Physik.
KINEMATIC WEYL SPACE-TIME MODELS Ph.D. Thesis [ZUR KINEMATIK WEYLSCHER RAUM-ZEIT-MODELLE]
Volker Perlick 1989 197 p In GERMAN
(ETN-90-96508) Avail: NTIS HC A09/MF A02

This model is based on the axiomatics of Ehlers and Pirani, which use the Lorentz signature (plus-plus-plus-minus). A field equation of the gravitation does not appear from a kinematic point of view. Mathematical propositions are proved in the following cases: the motion of infinitesimally neighboring observers towards one another and relative to an inertia compass, the red shift effects, the motion of two observers towards one another at the height of a third one (parallax effects) and the motion of a inertia compass relatively to an observer field, particularly the resulting precession. The methods of differential geometry were used in invariant writing with this aim. ESA

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N90-24972*# Texas A&M Univ., College Station.
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)/AMERICAN SOCIETY FOR ENGINEERING EDUCATION (ASEE) SUMMER FACULTY FELLOWSHIP PROGRAM-1989, VOLUME 1
William B. Jones, Jr., ed. and Stanley H. Goldstein, ed. (National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.) Dec. 1989 183 p Program held in Houston, TX, Aug. 1989
(Grant NGT-44-001-800)
(NASA-CR-185601-Vol-1; NAS 1.26:185601-Vol-1) Avail: NTIS HC A09/MF A02 CSCL 05I

The 1989 Johnson Space Center (JSC) National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program was conducted by Texas A and M University and JSC. The 10-week program was operated under the auspices of the ASEE. The program at JSC, as well as the programs at other NASA Centers, was funded by the Office of University Affairs, NASA Headquarters, Washington, D.C. The objectives of the program, which began nationally in 1964 and at JSC in 1965, are: (1) to further the professional knowledge of qualified engineering and science faculty members; (2) to stimulate an exchange of ideas between

participants and NASA; (3) to enrich and refresh the research and teaching activities of participants' institutions; and (4) to contribute to the research objective of the NASA Centers. For individual titles, see N90-24973 through N90-24984.

N90-24973*# Xavier Univ. of Louisiana, New Orleans. Dept. of Physics/Engineering.

TEMPERATURE DETERMINATION OF SHOCK LAYER USING SPECTROSCOPIC TECHNIQUES c70

Murty A. Akundi *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 19 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 20C

Shock layer temperature profiles are obtained through analysis of radiation from shock layers produced by a blunt body inserted in an arc jet flow. Spectral measurements of N2(+) have been made at 0.5 inch, 1.0 inch, and 1.4 inches from the blunt body. A technique is developed to measure the vibrational and rotational temperatures of N2(+). Temperature profiles from the radiation layers show a high temperature near the shock front and decreasing temperature near the boundary layer. Precise temperature measurements could not be made using this technique due to the limited resolution. Use of a high resolution grating will help to make a more accurate temperature determination. Laser induced fluorescence technique is much better since it gives the scope for selective excitation and a better spacial resolution. Author

N90-24974*# Houston Univ., TX. Dept. of Applied Mathematical Sciences.

A BAYESIAN APPROACH TO RELIABILITY AND CONFIDENCE Final Report c38

Ron Barnes *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 11 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 14D

The historical evolution of NASA's interest in quantitative measures of reliability assessment is outlined. The introduction of some quantitative methodologies into the Vehicle Reliability Branch of the Safety, Reliability and Quality Assurance (SR and QA) Division at Johnson Space Center (JSC) was noted along with the development of the Extended Orbiter Duration--Weakest Link study which will utilize quantitative tools for a Bayesian statistical analysis. Extending the earlier work of NASA sponsor, Richard Heydorn, researchers were able to produce a consistent Bayesian estimate for the reliability of a component and hence by a simple extension for a system of components in some cases where the rate of failure is not constant but varies over time. Mechanical systems in general have this property since the reliability usually decreases markedly as the parts degrade over time. While they have been able to reduce the Bayesian estimator to a simple closed form for a large class of such systems, the form for the most general case needs to be attacked by the computer. Once a table is generated for this form, researchers will have a numerical form for the general solution. With this, the corresponding probability statements about the reliability of a system can be made in the most general setting. Note that the utilization of uniform Bayesian priors represents a worst case scenario in the sense that as researchers incorporate more expert opinion into the model, they will be able to improve the strength of the probability calculations. Author

N90-24975*# Armstrong State Coll., Savannah, GA. Dept. of Biology.

EFFECT OF LOW AIR VELOCITIES ON THERMAL HOMEOSTASIS AND COMFORT DURING EXERCISE AT SPACE STATION OPERATIONAL TEMPERATURE AND HUMIDITY Final Report c54

Ronald J. Beumer *In* Texas A&M Univ., NASA/ASEE Summer Faculty Felloship Program-1989, Volume 1 Dec. 1989 15 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 05H

The effectiveness of different low air velocities in maintaining thermal comfort and homeostasis during exercise at space station operational temperature and humidity was investigated. Five male subjects exercised on a treadmill for successive ten minute periods at 60, 71, and 83 percent of maximum oxygen consumption at each of four air velocities, 30, 50, 80, and 120 ft/min, at 22 C and 62 percent relative humidity. No consistent trends or statistically significant differences between air velocities were found in body weight loss, sweat accumulation, or changes in rectal, skin, and body temperatures. Occurrence of the smallest body weight loss at 120 ft/min, the largest sweat accumulation at 30 ft/min, and the smallest rise in rectal temperature and the greatest drop in skin temperature at 120 ft/min all suggested more efficient evaporative cooling at the highest velocity. Heat storage at all velocities was evidenced by increased rectal and body temperatures; skin temperatures declined or increased only slightly. Body and rectal temperature increases corresponded with increased perception of warmth and slight thermal discomfort as exercise progressed. At all air velocities, mean thermal perception never exceeded warm and mean discomfort, greatest at 30 ft/min, was categorized at worst as uncomfortable; sensation of thermal neutrality and comfort returned rapidly after cessation of exercise. Suggestions for further elucidation of the effects of low air velocities on thermal comfort and homeostasis include larger numbers of subjects, more extensive skin temperature measurements and more rigorous analysis of the data from this study. Author

N90-24976*# Alabama Univ., Tuscaloosa.

NONINVASIVE ESTIMATION OF FLUID SHIFTS BETWEEN BODY COMPARTMENTS BY MEASUREMENT OF BIOELECTRIC CHARACTERISTICS Final Report c52

Phillip A. Bishop *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 15 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 06P

Previous research has established that bioelectrical characteristics of the human body reflect fluid status to some extent. It has been previously assumed that changes in electrical resistance (R) and reactance (X) are associated with changes in total body water (TBW). The purpose of the present pilot investigation was to assess the correspondence between body R and X and changes in estimated TBW and plasma volume during a period of bedrest (simulated weightlessness). R and X were measured pre-, during, and post- a 13 day bedrest status. Although a clear relationship was not elucidated, evidence was found suggesting that R and X reflect plasma volume rather than TBW. Indirect evidence provided by previous studies which investigated other aspects of the electrical/fluid relationship, also suggests the independence of TBW and electrical properties. With further research, a bioelectrical technique for noninvasively tracking fluid changes consequent to space flight may be developed. Author

N90-24977*# Houston Univ., Clear Lake, TX. School of Natural and Applied Sciences.

IDENTIFYING ATMOSPHERIC MONITORING NEEDS FOR SPACE STATION FREEDOM Final Report c54

Dennis M. Casserly *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 15 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 06K

The atmospheric monitoring needs for Space Station Freedom were identified by examining the following from an industrial hygiene perspective: the experiences of past missions; ground based tests of proposed life support systems; the unique experimental and manufacturing facilities; the contaminant load model; metabolic production; and a fire. A target list of compounds to be monitored is presented and information is provided relative to the frequency of analysis, concentration ranges, and locations for monitoring probes. Author

N90-24978*# Alma Coll., MI. Dept. of Exercise and Health Science.

EFFECT OF FLUID COUNTERMEASURES OF VARYING OSMOLARITY ON CARDIOVASCULAR RESPONSES TO ORTHOSTATIC STRESS Final Report c52

John E. Davis *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 14 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 06P

Current operational procedures for shuttle crewmembers include the ingestion of a fluid countermeasure approximately 2 hours before reentry into the earth's gravitational field. The ingestion of the fluid countermeasure is thought to restore plasma volume and improve orthostatic responses upon reentry. The present countermeasure consists of ingesting salt tablets and water to achieve an isotonic solution. It has yet to be determined whether this is the optimal drink to restore orthostatic tolerance. It is also not known whether the drink solution is effective in increasing plasma volume. The purpose here is to evaluate the effectiveness of drink solutions of different osmolarity on restoring plasma volume and orthostatic responses. A hypertonic drink solution was more effective in restoring plasma volume after dehydration than an isotonic solution. However, there were no differences in their effects on an orthostatic challenge. These data suggest that the plasma volume differences produced in this study were not sufficient to produce differences in the cardiovascular responses to an orthostatic challenge, or there are other changes that occur during space flight that are more important in determining orthostatic intolerance. Author

N90-24979*# Houston Univ., TX. Dept. of Applied Mathematical Sciences.
SOLVING PROBLEMS BY INTERROGATING SETS OF KNOWLEDGE SYSTEMS: TOWARD A THEORY OF MULTIPLE KNOWLEDGE SYSTEMS Final Report c64
Andre deKorvin *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 15 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 12A

The main purpose is to develop a theory for multiple knowledge systems. A knowledge system could be a sensor or an expert system, but it must specialize in one feature. The problem is that we have an exhaustive list of possible answers to some query (such as what object is it). By collecting different feature values, in principle, it should be possible to give an answer to the query, or at least narrow down the list. Since a sensor, or for that matter an expert system, does not in most cases yield a precise value for the feature, uncertainty must be built into the model. Also, researchers must have a formal mechanism to be able to put the information together. Researchers chose to use the Dempster-Shafer approach to handle the problems mentioned above. Researchers introduce the concept of a state of recognition and point out that there is a relation between receiving updates and defining a set valued Markov Chain. Also, deciding what the value of the next set valued variable is can be phrased in terms of classical decision making theory such as minimizing the maximum regret. Other related problems are examined. Author

N90-24980*# Military Academy, West Point, NY. Dept. of Physics.
UTILIZATION OF MOIRE PATTERNS AS AN ORBITAL DOCKING AID TO SPACE SHUTTLE/SPACE STATION FREEDOM Final Report c18
Edwin L. Dottery *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 16 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 22B

Moire patterns are investigated as possible docking aids for use between the National Space Transportations System (Space Shuttle Orbiter) and the Space Station Freedom. A sight reticle placed in optical conjunction with a docking target can generate moire fringes from which position and alignment can be inferred. Design specifications and a mathematical development to meet those specifications are discussed. A motion based simulator and experimental hardware have been constructed. Author

N90-24981*# Montana State Univ., Bozeman. Dept. of Chemistry.
ELECTROCHEMICAL CONTROL OF IODINE DISINFECTANT FOR SPACE TRANSPORTATION SYSTEM AND SPACE STATION POTABLE WATER Final Report c54
Richard D. Geer *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 15 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 06K

An electrochemical microbial check valve method (EC-MCV) for controlling the iodine disinfectant in potable water (PW) for NASA's space operations was proposed. The factors affecting the design and performance of the unit were analyzed. This showed that it would be feasible to construct a recyclable unit in a small volume that will operate in either an iodine removal or addition mode. The EC-MCV should remove active iodine species rapidly from PW, but the rapid delivery rates at end-use may make complete removal of excess I(-) difficult under some conditions. Its performace change with AgI buildup needs to be investigated, as this controls the time for recycling the unit. The EC-MCV has advantages over the passive microbial check valve (MCV) method currently in use, as it would allow precise control of the I2 level and would not introduce excess I(-) to the water. The presence of oxygen in the EC-MCV needs to be investigated as it could affect the efficiency of I2 addition and excess I(-) removal. Author

N90-24982*# North Carolina Univ., Chapel Hill. Dept. of Physical Education, Exercise and Sport Sciences.
OVERTRAINING AND EXERCISE MOTIVATION: A RESEARCH PROSPECTUS Final Report c53
Anthony C. Hackney *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 16 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 05I

The problems of exercise overtraining has recently become one of great interest to professionals in the field of human performance assessment. Quite obviously, the ultimate goal of the training process is to improve physical performance. However, excessive training can result in the opposite effect, that is, a performance decline and an impairment in the functional work capacity of the body. Research indicates that both psychological as well as physiological disturbances are quite common in overtrained individuals. For example, psychological changes include increased levels of depression, fatigue, and a lack of motivation. Similarly, impairment of the physiological function of the cardiovascular, metabolic, and endocrine systems also have been found. Some similarities may be found in the psychological and physiological states of crew members exposed to extended space flight and overtrained individuals. Therefore, the possibility exists that the crew members subjected to extended missions in space may develop overstressed or overtrained or both states during their flights. If such states do develop within the crew members, mission performance may be impaired. With these points as a background, the intent is to address potential research directions that NASA may consider viable and of a mutual interest to the researcher. A clear framework by which to begin discussion of research topics is needed; therefore, working definitions of overtraining and exercise motivation are presented. Subsequently, a proposed conceptional model of how exercise overtraining and motivation interact is presented. In support of the proposed model is a brief literature review of relevant areas. Potential research projects are presented and discussed. Author

N90-24983*# Texas Univ., Galveston. Dept. of Physical Therapy.
RESEARCH IN HUMAN PERFORMANCE RELATED TO SPACE: A COMPILATION OF THREE PROJECTS/PROPOSALS Final Report c54
Scott M. Hasson *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 13 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 05H

Scientific projects were developed in order to maximize

performance in space and assure physiological homeostatis upon return. Three projects that are related to this common goal were either initiated or formulated during the Faculty Fellowship Summer Program. The projects were entitled: (1) Effect of simulated weightlessness (bed rest) on muscle performance and morphology; (2) Effect of submaximal eccentric muscle contractions on muscle injury, soreness and performance: A grant proposal; and (3) Correlation between isolated joint dynamic muscle strength to end-effector strength of the push and pull extravehicular activity (EVA) ratchet maneuver. The purpose is to describe each of these studies in greater detail. Author

N90-24984*# Houston Univ., TX. Dept. of Psychology.
THE DEVELOPMENT OF EXPERTISE ON AN INTELLIGENT TUTORING SYSTEM Final Report **c63**
Debra Steele Johnson *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 1 Dec. 1989 14 p (For primary document see N90-24972 18-80)
Avail: NTIS HC A09/MF A02 CSCL 09B

An initial examination was conducted of an Intelligent Tutoring System (ITS) developed for use in industry. The ITS, developed by NASA, simulated a satellite deployment task. More specifically, the PD (Payload Assist Module Deployment)/ICAT (Intelligent Computer Aided Training) System simulated a nominal Payload Assist Module (PAM) deployment. The development of expertise on this task was examined using three Flight Dynamics Officer (FDO) candidates who had no previous experience with this task. The results indicated that performance improved rapidly until Trial 5, followed by more gradual improvements through Trial 12. The performance dimensions measured included performance speed, actions completed, errors, help required, and display fields checked. Suggestions for further refining the software and for deciding when to expose trainees to more difficult task scenarios are discussed. Further, the results provide an initial demonstration of the effectiveness of the PD/ICAT system in training the nominal PAM deployment task and indicate the potential benefits of using ITS's for training other FDO tasks. Author

N90-24985*# Texas A&M Univ., College Station.
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)/AMERICAN SOCIETY FOR ENGINEERING EDUCATION (ASEE) SUMMER FACULTY FELLOWSHIP PROGRAM-1989, VOLUME 2
William B. Jones, Jr., ed. and Stanley H. Goldstein, ed. (National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.) Dec. 1989 151 p Program held in Houston, TX, Aug. 1989
(Grant NGT-44-001-800)
(NASA-CR-185601-Vol-2; NAS 1.26:185601-Vol-2) Avail: NTIS HC A08/MF A01 CSCL 05I

The 1989 Johnson Space Center (JSC) National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program was conducted by Texas A and M University and JSC. The 10-week program was operated under the auspices of the ASEE. The program at JSC, as well as the programs at other NASA Centers, was funded by the Office of University Affairs, NASA Headquarters, Washington, D.C. The objectives of the program, which began nationally in 1964 and at JSC in 1965, are: (1) to further the professional knowledge of qualified engineering and science faculty members; (2) to stimulate an exchange of ideas between participants and NASA; (3) to enrich and refresh the research and teaching activities of participants' institutions; and (4) to contribute to the research objective of the NASA Centers. For individual titles, see N90-24986 through N90-24999.

N90-24986*# Missouri Univ., Independence. Dept. of Electrical and Computer Engineering.
OPTICAL CALCULATION OF CORRELATION FILTERS FOR A ROBOTIC VISION SYSTEM Final Report **c74**
Jerome Knopp *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 7 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 20A

A method is presented for designing optical correlation filters based on measuring three intensity patterns: the Fourier transform of a filter object, a reference wave and the interference pattern produced by the sum of the object transform and the reference. The method can produce a filter that is well matched to both the object, its transforming optical system and the spatial light modulator used in the correlator input plane. A computer simulation was presented to demonstrate the approach for the special case of a conventional binary phase-only filter. The simulation produced a workable filter with a sharp correlation peak. Author

N90-24987*# Houston Univ., TX. Dept. of Psychology.
KNOWLEDGE-BASED CONTROL OF AN ADAPTIVE INTERFACE Final Report **c54**
Roy Lachman *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 12 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 05H

The analysis, development strategy, and preliminary design for an intelligent, adaptive interface is reported. The design philosophy couples knowledge-based system technology with standard human factors approaches to interface development for computer workstations. An expert system has been designed to drive the interface for application software. The intelligent interface will be linked to application packages, one at a time, that are planned for multiple-application workstations aboard Space Station Freedom. Current requirements call for most Space Station activities to be conducted at the workstation consoles. One set of activities will consist of standard data management services (DMS). DMS software includes text processing, spreadsheets, data base management, etc. Text processing was selected for the first intelligent interface prototype because text-processing software can be developed initially as fully functional but limited with a small set of commands. The program's complexity then can be increased incrementally. The intelligent interface includes the operator's behavior and three types of instructions to the underlying application software are included in the rule base. A conventional expert-system inference engine searches the data base for antecedents to rules and sends the consequents of fired rules as commands to the underlying software. Plans for putting the expert system on top of a second application, a database management system, will be carried out following behavioral research on the first application. The intelligent interface design is suitable for use with ground-based workstations now common in government, industrial, and educational organizations. Author

N90-24988*# Stevens Inst. of Tech., Hoboken, NJ. Dept. of Electrical Engineering and Computer Science.
SOME ISSUES RELATED TO SIMULATION OF THE TRACKING AND COMMUNICATIONS COMPUTER NETWORK Final Report **c32**
Robert C. Lacovara *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 11 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 17B

The Communications Performance and Integration branch of the Tracking and Communications Division has an ongoing involvement in the simulation of its flight hardware for Space Station Freedom. Specifically, the communication process between central processor(s) and orbital replaceable units (ORU's) is simulated with varying degrees of fidelity. The results of investigations into three aspects of this simulation effort are given. The most general area involves the use of computer assisted software engineering (CASE) tools for this particular simulation. The second area of interest is simulation methods for systems of mixed hardware and software. The final area investigated is the application of simulation methods to one of the proposed computer network protocols for space station, specifically IEEE 802.4. Author

N90-24989*# Fordham Univ., New York, NY. Div. of Science and Mathematics.

THE EFFECTS OF SIMULATED HYPOGRAVITY ON MURINE BONE MARROW CELLS **c52**

DeSales Lawless *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 15 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 06P

Mouse bone marrow cells grown in complete medium at unit gravity were compared with a similar population cultured in conditions that mimic some aspects of microgravity. After the cells adjusted to the conditions that simulated microgravity, they proliferated as fetal or oncogenic populations; their numbers doubled in twelve hour periods. Differentiated subpopulations were depleted from the heterogeneous mixture with time and the undifferentiated hematopoietic stem cells increased in numbers. The cells in the control groups in unit gravity and those in the bioreactors in conditions of microgravity were monitored under a number of parameters. Each were phenotyped as to cell surface antigens using a panel of monoclonal antibodies and flow cytometry. Other parameters compared included: pH, glucose uptake, oxygen consumption and carbon-dioxide production. Nuclear DNA was monitored by flow cytometry. Functional responses were studied by mitogenic stimulation by various lectins. The importance of these findings should have relevance to the space program. Cells should behave predictably in zero gravity; specific populations can be eliminated from diverse populations and other populations isolated. The availability of stem cell populations will enhance both bone marrow and gene transplant programs. Stem cells will permit developmental biologists study the paths of hematopoiesis. Author

N90-24990*# New Mexico State Univ., Las Cruces. Dept. of Mechanical Engineering.

THERMODYNAMIC AND FLUID MECHANIC ANALYSIS OF RAPID PRESSURIZATION IN A DEAD-END TUBE Final Report **c70**

Ian H. Leslie *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 15 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 20A

Three models have been applied to very rapid compression of oxygen in a dead-ended tube. Pressures as high as 41 MPa (6000 psi) leading to peak temperatures of 1400 K are predicted. These temperatures are well in excess of the autoignition temperature (750 K) of teflon, a frequently used material for lining hoses employed in oxygen service. These findings are in accord with experiments that have resulted in ignition and combustion of the teflon, leading to the combustion of the stainless steel braiding and catastrophic failure. The system analyzed was representative of a capped off-high-pressure oxygen line, which could be part of a larger system. Pressurization of the larger system would lead to compression in the dead-end line, and possible ignition of the teflon liner. The model consists of a large plenum containing oxygen at the desired pressure (500 to 6000 psi). The plenum is connected via a fast acting valve to a stainless steel tube 2 cm inside diameter. Opening times are on the order of 15 ms. Downstream of the valve is an orifice sized to increase filling times to around 100 ms. The total length from the valve to the dead-end is 150 cm. The distance from the valve to the orifice is 95 cm. The models describe the fluid mechanics and thermodynamics of the flow, and do not include any combustion phenomena. A purely thermodynamic model assumes filling to be complete upstream of the orifice before any gas passes through the orifice. This simplification is reasonable based on experiment and computer modeling. Results show that peak temperatures as high as 4800 K can result from recompression of the gas after expanding through the orifice. An approximate transient model without an orifice was developed assuming an isentropic compression process. An analytical solution was obtained. Results indicated that fill times can be considerably shorter than valve opening times. The third model was a finite difference, 1-D transient compressible flow model. Results from the code show the recompression effect but predict much lower peak temperatures than the thermodynamic model. Author

N90-24991*# Pittsburgh Univ., PA. Dept. of Information Science.

A COMPARISON OF TWO NEURAL NETWORK SCHEMES FOR NAVIGATION Final Report **c63**

Paul W. Munro *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 10 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 09B

Neural networks have been applied to tasks in several areas of artificial intelligence, including vision, speech, and language. Relatively little work has been done in the area of problem solving. Two approaches to path-finding are presented, both using neural network techniques. Both techniques require a training period. Training under the back propagation (BPL) method was accomplished by presenting representations of (current position, goal position) pairs as input and appropriate actions as output. The Hebbian/interactive activation (HIA) method uses the Hebbian rule to associate points that are nearby. A path to a goal is found by activating a representation of the goal in the network and processing until the current position is activated above some threshold level. BPL, using back-propagation learning, failed to learn, except in a very trivial fashion, that is equivalent to table lookup techniques. HIA, performed much better, and required storage of fewer weights. In drawing a comparison, it is important to note that back propagation techniques depend critically upon the forms of representation used, and can be sensitive to parameters in the simulations; hence the BPL technique may yet yield strong results. Author

N90-24992*# Virginia Commonwealth Univ., Richmond. Dept. of Mathematical Sciences.

EVALUATING STATISTICAL PROCESS CONTROL (SPC) TECHNIQUES AND COMPUTING THE UNCERTAINTY OF FORCE CALIBRATIONS Final Report **c38**

Sharon E. Navard *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 15 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 14D

In recent years there has been a push within NASA to use statistical techniques to improve the quality of production. Two areas where statistics are used are in establishing product and process quality control of flight hardware and in evaluating the uncertainty of calibration of instruments. The Flight Systems Quality Engineering branch is responsible for developing and assuring the quality of all flight hardware; the statistical process control methods employed are reviewed and evaluated. The Measurement Standards and Calibration Laboratory performs the calibration of all instruments used on-site at JSC as well as those used by all off-site contractors. These calibrations must be performed in such a way as to be traceable to national standards maintained by the National Institute of Standards and Technology, and they must meet a four-to-one ratio of the instrument specifications to calibrating standard uncertainty. In some instances this ratio is not met, and in these cases it is desirable to compute the exact uncertainty of the calibration and determine ways of reducing it. A particular example where this problem is encountered is with a machine which does automatic calibrations of force. The process of force calibration using the United Force Machine is described in detail. The sources of error are identified and quantified when possible. Suggestions for improvement are made. Author

N90-24993*# Texas Univ., Galveston. Dept. of Pharmacology and Toxicology.

CONSERVATION OF BODY CALCIUM BY INCREASED DIETARY INTAKE OF POTASSIUM: A POTENTIAL MEASURE TO REDUCE THE OSTEOPOROSIS PROCESS DURING PROLONGED EXPOSURE TO MICROGRAVITY Final Report **c52**

Bohdan R. Nechay *In* Texas A&M Univ., NASA/ASEE Summer

Faculty Fellowship Program-1989, Volume 2 Dec. 1989 6 p
(For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 06P

During the 1988 NASA Summer Faculty Fellowship Program, it was proposed that the loss of skeletal calcium upon prolonged exposure to microgravity could be explained, in part, by a renal maladjustment characterized by an increased urinary excretion of calcium. It was theorized that because the conservation of body fluids and electrolytes depends upon the energy of adenosine triphosphate and enzymes that control the use of its energy for renal ion transport, an induction of renal sodium and potassium-dependent adenosine triphosphatase (Na + K ATPase) by oral loading with potassium would increase the reabsorption of sodium directly and that of calcium indirectly, leading to improved hydration and to reduced calcium loss. Preliminary studies showed the following. Rats drinking water containing 0.2 M potassium chloride for six to 13 days excreted in urine 22 muEq of calcium and 135 muEq of sodium per 100 grams of body weight per day. The corresponding values for control rats drinking tap water were 43 muEq and 269 muEq respectively. Renal Na + K ATPase activity in potassium loaded rats was higher than in controls. Thus, oral potassium loading resulted in increased Na + K ATPase activity and diminished urinary excretion of calcium and of sodium as predicted by the hypothesis. An extension of these studies to humans has the potential of resulting in development of harmless, non-invasive, drug-free, convenient measures to reduce bone loss and other electrolyte and fluid problems in space travelers exposed to prolonged periods of microgravity. Author

N90-24994*# DePaul Univ., Chicago, IL. Dept. of Computer Science.
A COMPARISON OF SELECT IMAGE-COMPRESSION ALGORITHMS FOR AN ELECTRONIC STILL CAMERA Final Report **c35**
Rosalee Nerheim *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 11 p
(For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 14B

This effort is a study of image-compression algorithms for an electronic still camera. An electronic still camera can record and transmit high-quality images without the use of film, because images are stored digitally in computer memory. However, high-resolution images contain an enormous amount of information, and will strain the camera's data-storage system. Image compression will allow more images to be stored in the camera's memory. For the electronic still camera, a compression algorithm that produces a reconstructed image of high fidelity is most important. Efficiency of the algorithm is the second priority. High fidelity and efficiency are more important than a high compression ratio. Several algorithms were chosen for this study and judged on fidelity, efficiency and compression ratio. The transform method appears to be the best choice. At present, the method is compressing images to a ratio of 5.3:1 and producing high-fidelity reconstructed images. Author

N90-24995*# Texas Lutheran Coll., Seguin. Dept. of Biology.
THE USE OF UNDERWATER DYNAMOMETRY TO EVALUATE TWO SPACE SUITS Final Report **c54**
W. G. Squires *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 6 p
(For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 06K

Four Astronauts were instrumented and donned one of three extravehicular activity (EVA) suits: the currently in use shuttle suit (STS), the Mark III (MK3), and the AX5. The STS was used as the comparison suit because of approved status. Each subject performed ten different exercises in each suit in three different manners (static, dynamic and fatigue) in two different environments, WETF and KC-135 (KC-135 not completed as of this report). Data were recorded from a flight qualified underwater dynamometer (Cybex power head) with a TEAC multichannel recorder/tape and downloaded into the VAX computer system for analysis. Also direct hard copy strip chart recordings were made for backup comparisons. Data were analyzed using the ANOVA procedure and results were graphed and reported without interpretation to the NASA/JSC ABL manager. Author

N90-24996*# Minnesota Univ., Minneapolis. Dept. of Aerospace Engineering and Mechanics.
FINITE ELEMENT FORMULATIONS FOR COMPRESSIBLE FLOWS Final Report **c34**
Tayfun E. Tezduyar *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 8 p
(For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 20D

Researchers started their studies on the development and application of computational methods for compressible flows. Particular attention was given to proper numerical treatment of sharp layers occurring in such problems and to general mesh generation capabilities for intricate computational geometries. Mainly finite element methods enhanced with several state-of-the art techniques (such as the streamline-upwind/Petrov-Galerkin, discontinuity capturing, adaptive implicit-explicit, and trouped element-by-element approximate factorization schemes) were employed. Author

N90-24997*# Stevens Inst. of Tech., Hoboken, NJ. Dept. of Electrical Engineering and Computer Science.
OPTICAL RATE SENSOR ALGORITHMS Final Report **c74**
Jo A. Uhde-Lacovara *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 11 p
(For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 20F

Optical sensors, in particular Charge Coupled Device (CCD) arrays, will be used on Space Station to track stars in order to provide inertial attitude reference. Algorithms are presented to derive attitude rate from the optical sensors. The first algorithm is a recursive differentiator. A variance reduction factor (VRF) of 0.0228 was achieved with a rise time of 10 samples. A VRF of 0.2522 gives a rise time of 4 samples. The second algorithm is based on the direct manipulation of the pixel intensity outputs of the sensor. In 1-dimensional simulations, the derived rate was with 0.07 percent of the actual rate in the presence of additive Gaussian noise with a signal to noise ratio of 60 dB. Author

N90-24998*# Mississippi Valley State Univ., Itta Bena. Dept. of Computer Science and Mathematics.
WEIGHT AND COST FORECASTING FOR ADVANCED MANNED SPACE VEHICLES Final Report **c18**
Raymond Williams *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 7 p
(For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 22B

A mass and cost estimating computerized methology for predicting advanced manned space vehicle weights and costs was developed. The user friendly methology designated MERCER (Mass Estimating Relationship/Cost Estimating Relationship) organizes the predictive process according to major vehicle subsystem levels. Design, development, test, evaluation, and flight hardware cost forecasting is treated by the study. This methodology consists of a complete set of mass estimating relationships (MERs) which serve as the control components for the model and cost estimating relationships (CERs) which use MER output as input. To develop this model, numerous MER and CER studies were surveyed and modified where required. Additionally, relationships were regressed from raw data to accommodate the methology. The models and formulations which estimated the cost of historical vehicles to within 20 percent of the actual cost were selected. The result of the research, along with components of the MERCER Program, are reported. On the basis of the analysis, the following conclusions were established: (1) The cost of a spacecraft is best estimated by summing the cost of individual subsystems; (2) No one cost equation can be used for forecasting the cost of all spacecraft; (3) Spacecraft cost is highly correlated with its mass; (4) No study surveyed contained sufficient formulations to autonomously forecast the cost and weight of the entire advanced manned vehicle

spacecraft program; (5) No user friendly program was found that linked MERs with CERs to produce spacecraft cost; and (6) The group accumulation weight estimation method (summing the estimated weights of the various subsystems) proved to be a useful method for finding total weight and cost of a spacecraft. Author

N90-24999*# Texas A&M Univ., Galveston. Dept. of Marine Engineering.
A PRELIMINARY DESIGN OF INTERIOR STRUCTURE AND FOUNDATION OF AN INFLATABLE LUNAR HABITAT Final Report **c54**
Paul K. Yin *In* Texas A&M Univ., NASA/ASEE Summer Faculty Fellowship Program-1989, Volume 2 Dec. 1989 12 p (For primary document see N90-24985 18-80)
Avail: NTIS HC A08/MF A01 CSCL 06K

A preliminary structural design and analysis of an inflatable habitat for installation on the moon was completed. The concept takes the shape of a sphere with a diameter of approximately 16 meters. The interior framing provides five floor levels and is enclosed by a spherical air-tight membrane holding an interior pressure of 14.7 psi (101.4kpa). The spherical habitat is to be erected on the lunar surface with the lower one third below grade and the upper two thirds covered with a layer of lunar regolith for thermal insulation and shielding against radiation and meteoroids. The total dead weight (earth weight) of the structural aluminum, which is of vital interest for the costly space transportation, is presented. This structural dead weight represents a preliminary estimate without including structural details. The design results in two versions: one supports the weight of the radiation shielding in case of deflation of the fabric enclosure and the other assumes that the radiation shielding is self supporting. To gain some indication of the amount of structural materials needed if the identical habitat were installed on Mars and Earth, three additional design versions were generated where the only difference is in gravity. These additional design versions are highly academic since the difference will be much more than in gravity alone. The lateral loading due to dust storms on Mars and wind loads on Earth are some examples. The designs under the lunar gravity are realistic. They may not be adequate for final material procurement and fabrication, however, as the connection details, among other reasons, may effect the sizes of the structural members. Author

N90-24367*# Iowa State Univ. of Science and Technology, Ames.
EXPERIMENTS AND OTHER METHODS FOR DEVELOPING EXPERTISE WITH DESIGN OF EXPERIMENTS IN A CLASSROOM SETTING
John W. Patterson *In* NASA, Langley Research Center, National Educators' Workshop: Update 1989 Standard Experiments in Engineering Materials Science and Technology May 1990 p 119-131 (For primary document see N90-24350 18-23)
Avail: NTIS HC A09/MF A02 CSCL 05D

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N90-25000*# Kansas Univ., Lawrence.
KEEPING THE DREAM ALIVE: MANAGING THE SPACE STATION PROGRAM, 1982 TO 1986 Final Report
Thomas J. Lewin and V. K. Narayanan (Rutgers - The State Univ., New Brunswick, NJ.) Washington NASA Jul. 1990 178 p (Contract NASw-4248)
(NASA-CR-4272; NAS 1.26:4272) Avail: NTIS HC A09/MF A01 CSCL 05A

The management is described and analyzed of the formative years of the NASA Space Station Program (1982 to 1986), beginning with the successful initiative for program approval by Administrator James M. Beggs through to the decision to bring program management to Reston, Virginia. Emphasis is on internal management issues related to the implementation of the various phases of the program. Themes examined are the problem of bringing programmatic and institutional interests together and focusing them to forward the program; centralized versus decentralized control of the program; how the history of NASA and of the individual installations affected the decisions made; and the pressure from those outside NASA. The four sections are: (1) the decision to build the space station, (2) the design of the management experiment, (3) the experiment comes to life, and (4) the decision reversal. Author

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N90-25001# General Accounting Office, Washington, DC. Resources, Community, and Economic Development Div.
SATELLITE DATA ARCHIVING: US AND FOREIGN ACTIVITIES AND PLANS FOR ENVIRONMENTAL INFORMATION Report to Congressional requesters
Sep. 1988 53 p
(GAO/RCED-88-201; B-231276) Avail: NTIS HC A04/MF A01

The environmental satellite data archiving activities and plans of three Federal agencies are examined. These agencies are the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), and the Department of Interior's U.S. Geological Survey (USGS). International archiving practices are also investigated. Many countries collect and archive not only their own data but also data from other countries' satellites. The three U.S. agencies mentioned obtain, maintain, and disseminate large amounts of varying types of data and do some archiving, but budgetary constraints are a cause for concern about future capabilities.
J.P.S.

N90-25002 Carnegie-Mellon Univ., Pittsburgh, PA.
EXPLANATION OF BAYESIAN CONDITIONING FOR DECISION SUPPORT SYSTEMS Ph.D. Thesis
Christopher Elsaesser 1989 158 p
Avail: Univ. Microfilms Order No. DA9006206

Public sector decision-makers have not developed reliance on decision support systems that employ Bayesian deduction. One impediment is the difficulty users have understanding use of Bayes' rule. One way to solve this problem might be to include facilities that explain Bayesian conditioning in the decision aids. The possibility to improve user acceptance of normative decision support systems is examined through the development of an explanatory facility. A theoretical perspective on the understanding and explanation of uncertainty reasoning was needed to guide development of an explanation method. Such a perspective, emphasizing aspects particularly important to Bayesian conditioning, is developed. According to this perspective, users understand reasoning that appears to reflect their own. Procedures are proposed that account for systematic biases people exhibit in assessing probability due to neglect of prior probabilities and that account for observations that people do, at times, assess probability in a manner consistent with Bayes' rule factors are proposed to account for the selection of one set of procedures over another. It is hypothesized that natural language representation of uncertainty is the key to evoking the procedures consistent with Bayesian conditioning. A prototype explanation facility was developed to study if a particular translation of Bayesian conditioning to natural language can improve user understanding. The facility translates probabilities to linguistic terms which are inserted in a sentence template derived from Polya's patterns of plausible inference. Three experiments examined user acceptance and understanding. First, demonstration of the facility to a representative group of regulatory decision-makers indicated that

the explanations are acceptable to the target user group. Next, results of an experiment indicated statistically significant improvements in subjective estimates of posterior probability in three of seven tasks due to the explanations. Finally, statistically significant improvements in subjective confidence due to explanations was detected. Dissert. Abstr.

N90-25003# Lawrence Livermore National Lab., CA.
LINE SIMPLIFICATION AND DIGITAL CARTOGRAPHIC DATABASES M.A. Thesis - San Jose State Univ.
Hoyt Walker Nov. 1989 227 p
(Contract W-7405-eng-48)
(DE90-010194; UCRL-LR-103168) Avail: NTIS HC A11/MF A01

This thesis examines one component of the cartographic generalization process, line simplification, and its implementation with computer technology. The effectiveness of line simplification techniques in producing useful maps from digital map data is studied. Many techniques have been proposed to simplify lines; several of these have been implemented here. The approaches have been compared on their ability to simplify lines from two cartographic databases over both modest and extreme changes in scale. The comparisons are based on the simplification of individual lines, on the production of complete maps, and on mathematical measures of performance. One promising technique is enhanced to overcome certain limitations which are apparent during extreme scale change. The effect of map projections on the performance of such techniques is considered. While much additional work is needed, this study indicates that line simplification techniques can extend the range of scales over which certain cartographic databases can be utilized. DOE

N90-25004# Stanford Univ., CA. Dept. of Psychology.
ACQUIRING GENERALIZATIONS TO ORGANIZE HUMAN DATABASES Interim Report, 1 Sep. 1988 - 1 Sep. 1989
John P. Clapper and Gordon H. Bower 26 Feb. 1990 16 p
(Grant AF-AFOSR-0282-87; AF Proj. 2313)
(AD-A219835; AFOSR-90-0363TR) Avail: NTIS HC A03/MF A01 CSCL 05/8

This report describes a program of empirical and theoretical research on how category-level generalizations facilitate human performance in learning tasks, especially when the categories are acquired in an unsupervised environment. An information-processing model is described in which people are assumed to spontaneously search for patterns and regularities among the training instances, and use them as a basis for forming general concepts. These concepts, in turn, enable learners to economize their encoding of further instances by focusing selectively on their most informative features. The resulting memory organization appear to optimize later access to the information from long-term memory. Several memory experiments are described which provide strong support for these claims. Two similarity experiments are also reported; these demonstrate that concept learning affects the evaluation and judgement of training instances as predicted by our theory, specifically, that comparison are strongly affected by the informative (surprising or unusual) features of the objects being compared. A new procedure is also introduced for observing the spontaneous acquisition of concepts in an unsupervised task. This task provides a trial-by-trial index of the strength of subjects' default generalizations about the concept. GRA

N90-25005# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
MAINTAINING MULTIPLE REPRESENTATIONS OF DYNAMIC DATA STRUCTURES
Michiel H. Smid, Mark H. Overmars, Leen Irenvliet, and Peter vanEmdeBoas (Amsterdam Univ., Netherlands) Aug. 1988 29 p Sponsored by Netherlands Organization for Scientific Research
(RUU-CS-88-27; ETN-90-96850) Avail: NTIS HC A03/MF A01

Problems involved in maintaining multiple representations of dynamic data structures are investigated. Applications to data structures between a number of processors is discussed. Ways of maintaining these structures efficiently under insertions and deletions are presented. A strategy in which a central data structure is stored in one processor to which all the other processors are connected is described. Updates are first preprocessed in the central structure. Several solutions to multiple representation problems are presented. Ways in which a client structure can be updated in a time proportional to the size of the changes in the structure are outlined. ESA

N90-25006# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
DATA CONVERSIONS IN ABSTRACT DATA TYPES
Nico Verwer Sep. 1989 29 p
(RUU-CS-88-30; ETN-90-96852) Avail: NTIS HC A03/MF A01

The theory of algebraic specifications is reviewed and a notion of programs is presented. A correctness condition for data conversions is proposed. Some of its properties are investigated. The notion of data conversion is generalized to that of abstract data conversion in order to be able to translate between arbitrary models of a specification. Aspects of constructing data conversions for a particular specification are discussed. ESA

N90-25007# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
DISTRIBUTED COMPUTING ON TRANSITIVE NETWORKS: THE TORUS
Paul W. Beame and Hans L. Bodlaender Sep. 1988 14 p
(RUU-CS-88-31; ETN-90-96853) Avail: NTIS HC A03/MF A01

The usefulness of transitive networks in distributed computation with known topology is discussed. The classes of transitive networks which prove useful are the ring and complete network as well as the two dimensional grid network with boundary connections, i.e., the torus. The bit and message complexity of computing non-constant functions on an asynchronous torus are considered. In such a torus, the processors are identical except that they have one input bit. Non-constant functions with a bit complexity linear in the number of processors on the torus are outlined. ESA

N90-25008# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
ON RECTILINEAR LINK DISTANCE
Mark deBerg May 1989 28 p Sponsored by Netherlands Organization for Scientific Research
(RUU-CS-89-13; ETN-90-96868) Avail: NTIS HC A03/MF A01

A data structure using O(n log n) storage such that given any two query points s and t in P, a shortest path from s to t can be computed, is described. For the case where both query points are vertices of P, the query time is determined to be O(1+l) where l is length of a shortest path. If the query points are arbitrary points inside P then the query time becomes O(log n+l). The path that is found is optimal in the rectilinear link metric, and is shown to be optimal in the l sub 1 metric as well. ESA

N90-25009# Maryland Univ., College Park. Dept. of Computer Science.
USING INTEGRITY CONSTRAINTS TO CONTROL SEARCH IN KNOWLEDGE BASE SYSTEMS
Theresa Gaasterland, Mark Giuliano, Anne Litcher, Yuan Liu, and Jack Minker Feb. 1990 46 p
(Grants AF-AFOSR-0152-88; NSF IRI-86-09170)
(AD-A221291; UMIACS-TR-90-27; CS-TR-2416) Avail: NTIS HC A03/MF A01 CSCL 12/5

A knowledge base system combines data management and reasoning capabilities. It can be used to store and manipulate a body of knowledge which consists of a set of rules and facts. The rules and facts in a knowledge base capture syntactic information. In contrast, integrity constraints contribute semantic information about the represented knowledge. They impose restrictions on the states of the world that a knowledge base can model. Typically, integrity constraints are used to update and maintain the knowledge base, but they can also be a powerful

tool for answering queries. A logic programming system augmented with constraint processing, data storage, and data manipulation capabilities forms the basis for a knowledge base system. Both a runtime approach and a compiled approach to using integrity constraints in logic programming systems to identify and eliminate unproductive search activity have been implemented within an existing parallel logic programming system, PRISM. We have thus extended PRISM to be a testbed for knowledge base applications. The extended system provides the basis for a series of experiments which: (1) compare the performance of the compiled approach and the runtime approach, (2) demonstrate that significant classes of knowledge representation domains can use integrity constraints effectively, and (3) reveal additional techniques necessary to put the theoretical approaches into practice. GRA

N90-25010# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
MANAGING PARALLELISM AND RESOURCES IN SCIENTIFIC DATAFLOW PROGRAMS Ph.D. Thesis, 1989
David E. Culler Mar. 1990 245 p
(Contract N00014-84-K-0099)
(AD-A221398; MIT/LCS/TR-446) Avail: NTIS HC A11/MF A02 CSCL 12/5

Exploiting parallelism to achieve high performance invariably increases the resource requirements of a program. This is particularly serious under dynamic dataflow execution, because all the potential parallelism in a program is exposed. The resource requirements can be excessive, often leading to deadlock. This phenomenon is documented using parallelism and resource profiles derived under an ideal dataflow execution model. This report examines how resource requirements can be managed effectively by controlling the ways in which parallelism is exposed. A mechanism for controlling parallelism in scientific programs, called k-bounded loops, is presented. This involves compiling loops into dataflow graphs in a manner that allows the maximum number of concurrent iterations to be set dynamically, when the loop is invoked. A policy for employing this mechanism is developed and tested on a variety of programs. Through static analysis of the program, parametric resource expressions are formulated and the potential parallelism is characterized. Based on this analysis, the program is augmented with resource management code that computes the k-bounds by simple formulae, involving program variables and an overall resource parameter that reflects the capacity of the machine. This approach is shown to be effective for containing the resource requirements of scientific dataflow programs, while exposing adequate parallelism. GRA

N90-25011# Civil Aeromedical Inst., Oklahoma City, OK.
INDEX OF FAA OFFICE OF AVIATION MEDICINE REPORTS: 1961 THROUGH 1989 Final Report
William E. Collins, Michael E. Wayda, and Nancy E. Baxter Jan. 1990 61 p Sponsored by FAA, Washington, DC
(AD-A221414; DOT/FAA/AM-90/1) Avail: NTIS HC A04/MF A01 CSCL 06/5

An index to Office of Aviation Medicine Reports (1964 to 1989) and Civil Aeromedical Research Institute Reports (1961 to 1963) is presented as a reference for those engaged in aviation medicine and related activities. It lists all FAA aviation medicine reports published from 1961 through 1989: chronologically, alphabetically by author, and alphabetically by subject. GRA

N90-25012# Sandia National Labs., Albuquerque, NM.
ENHANCING A RELATIONAL DATABASE: STEPWISE, BOTTOM-UP DESIGN
Donna S. Eaton 1990 14 p Presented at the North American INGRES Users Association (NAIUA) Conference, Salt Lake City, UT, 6-10 May 1990
(Contract DE-AC04-76DP-00789)
(DE90-010834; SAND-89-2727C; CONF-9005167-4) Avail: NTIS HC A03/MF A01

Relational databases have gained in popularity over previous methods for many reasons. Users like them for their simplicity. Users and developers appreciate the data independence features of relational systems; details of storage structures and access strategies are left to the database software itself. Finally, relational databases, properly designed, can be easily modified for various new requirements or as a planned bottom-up design step toward a corporate information system. The enhancement described here consisted of changing a mainframe database containing information about companies to add another customer's information including current company, company address, and historical company data. DOE

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N90-25013# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
MINIMIZING SUMS OF ADDITION CHAINS
H. Zantema Jun. 1989 25 p
(RUU-CS-89-15; ETN-90-96870) Avail: NTIS HC A03/MF A01

Bounds on sums of addition chains are derived and properties of optimal addition chains are studied according to the sum cost criterion. It turns out that the last step in an optimal addition chain for an even number is always a doubling, and the sum of an optimal addition chain for an odd number n is asymptotically very close to (5n)/2. If the cost of the multiplications is taken into account, then the sum of the elements of an addition chain for n is determined to be a better measure for the cost of computing x to the n power than the length. ESA

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N90-25014# General Accounting Office, Washington, DC. Information Management and Technology Div.
MILITARY SPACE OPERATIONS: SHUTTLE AND SATELLITE COMPUTER SYSTEMS DO NOT MEET PERFORMANCE OBJECTIVES Report to the Chairman, Subcommittee on Defense, Committee on Appropriations, House of Representativ
Aug. 1988 46 p
(GAO/IMTEC-88-7; B-205335) Avail: NTIS HC A03/MF A01

An assessment of computer and communication systems for military space operations is presented, with emphasis on the Air Force's development and acquisition of the Consolidated Space Operations Center near Colorado Springs, Colorado. This facility consists of a satellite operations complex, a shuttle operations complex, a supporting communications system, and a related data system modernization project for the satellite operations facility in Sunnyvale, California. The report details General Accounting Office (GAO) observations on the cancellation of the shuttle operations complex, development of new computer and communication systems for both the satellite operations complex and the Sunnyvale facility, and Air Force plans for the long-range satellite control system architecture, which will require significant advances in data processing and communication system technologies and performance. J.P.S.

N90-25015# General Accounting Office, Washington, DC. National Security and International Affairs Div.
SPACE EXPLORATION: NASA'S DEEP SPACE MISSIONS ARE EXPERIENCING LONG DELAYS Briefing report to the Chairman, Subcommittee on Science, Technology, and Space, Committee on Commer
May 1988 27 p
(GAO/NSIAD-88-128BR; B-230525) Avail: NTIS HC A03/MF A01

The cost, schedule, performance, and status of the following

NASA programs are assessed by the General Accountng Office: Galileo mission to Jupiter; Ulysses mission to the sun, a joint project with the European Space Agency (ESA); Magellan mission to Venus; and Mars Observer mission. The causes and impacts of project delays are discussed. Separate reports provide more detailed descriptions of each mission. The purpose of these deep space missions is to improve scientific knowledge of our solar system and selected planets in it. J.P.S.

N90-25016# General Accounting Office, Washington, DC. National Security and International Affairs Div.
SPACE SHUTTLE: CHANGES TO THE SOLID ROCKET MOTOR CONTRACT Report to Congressional requesters
Aug. 1988 11 p
(GAO/NSIAD-88-203; B-229005) Avail: NTIS HC A03/MF A01

Changes to the Space Shuttle solid rocket motor (SRM) contract, made after a Presidential Commission concluded that the SRM caused the Challenger accident, are discussed. The amount of work to be done by Morton Thiokol Incorporated increased significantly due to redesigning the motor joints, making other design changes to enhance the motor's safety and reliability, and incorporating the changes into 13 sets of motors of 2 motors each. The estimated contract costs increased substantially and are expected to go still higher after additional contract changes are negotiated. The basis for determining the fee to be paid was changed from specific cost and performance incentives to more subjective evaluations by NASA of Thiokol's performance in areas such as quality assurance, cost control, and project management. J.P.S.

N90-25017# Committee on Appropriations (U.S. Senate).
DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS FOR FISCAL YEAR 1990, PART 2
GPO 1990 684 p Hearings on H.R. 2916 before the Committee on Appropriations, 101st Congress, 1st Session, 3-4 Apr., 2-3 May, and 15-16 May 1989
(S-Hrg-101-345-Pt-2; GPO-92-982) Avail: Committee on Appropriations, Senate, Washington, DC 20515 HC free; SOD HC $20.00 as 552-070-07648-4

Hearings before a subcommittee of the Senate Committee on Appropriations are presented. Included are the verbal and written testimony and the budget estimates for the National Aeronautics and Space Administration for fiscal year 1990. The testimony outlines budgetary information and justifications for expenditures, primarily to continue programs previously approved by the Congress. For individual titles, see N90-25018 through N90-25019.

N90-25018# Committee on Appropriations (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, 2 MAY 1989
In its Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations for Fiscal Year 1990, Part 2 1990 p 261-307 (For primary document see N90-25017 18-84)
Avail: Committee on Appropriations, Senate, Washington, DC 20515 HC free; SOD HC $20.00 as 552-070-07648-4

Following the opening statements of the Subcommittee members of the Committee on Appropriations, the National Aeronautics and Space Administration presented its fiscal year 1990 budget. Comments on the various budget items included justifications for space flight, Space Station Freedom, university research programs, space commercialization, space operations, employee training, safety programs and devices, and senior executive pay. Budget cuts, should they occur, will probably result in eliminating the space station which is considered to be the cornerstone of the U.S. program. The U.S.S.R.'s and Japan's space research and development programs were also discussed. J.P.S.

N90-25019# Committee on Appropriations (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, 3 MAY 1989
In its Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations for Fiscal Year 1990, Part 2 1990 p 309-434 (For primary document see N90-25017 18-84)
Avail: Committee on Appropriations, Senate, Washington, DC 20515 HC free; SOD HC $20.00 as 552-070-07648-4

The second day's hearings for NASA by the Senate Committee on Appropriations, covered the following topics: NASA's cooperation with the space program of the Department of Defense; NASA's educational programs at all levels; Jet Propulsion Laboratory- produced NASA programs on cable TV, available to schools and museums; the status of the Challenger crew memorial trust fund established by Congress to create and operate the Challenger Center for Space Science Education; international agreements for space missions, two of which are the space station and CRAF-Cassini (which will study Saturn and other outer giant planets, and a comet); supersonic transports, including investigations into ways of reducing sonic booms and ozone depletion; deep space missions; cost overruns; structural spares; space station power requirements; tilt rotor technology; shuttle operations; the mission to planet earth, expected to be a new start for 1991; NASA cooperation with the Environmental Agency, the National Science Foundation and other agencies concerned with the environment; and finally, NASA's employment of women and minorities in positions of grade GS-12 or higher. All written testimony and submittals for the record are also included. J.P.S.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

No abstracts in this category.

88 SPACE SCIENCES (GENERAL)

N90-25020# Technische Univ., Berlin (Germany, F.R.). Inst. fuer Astronomie und Astrophysik.
[ACTIVITIES REPORT OF THE INSTITUTE FOR ASTRONOMY AND ASTROPHYSICS] Annual Report, 1988 [INSTITUT FUER ASTRONOMIE UND ASTROPHYSIK DER TECHNISCHEN UNIVERSITAET BERLIN: JAHRESBERICHT FUER DAS JAHR 1988]
K. Beuermann 1989 8 p In GERMAN
(Mitt-10; ETN-90-96462) Avail: NTIS HC A02/MF A01

The subjects studied and the researchers are listed. The main research areas were solar system, helium stars, cataclysmic variables and double x ray stars, extragalactic x ray sources, chemistry of the dust formation, dynamics of galaxies and formation of interstellar dust. ESA

N90-25021# Space Research Organization Netherlands, Utrecht.
[ACTIVITIES REPORT OF THE NETHERLANDS SPACE RESEARCH ORGANIZATION] Annual Report, 1988
May 1989 213 p
(ETN-90-96927) Avail: NTIS HC A10/MF A02

Space research into x ray astronomy, infrared astronomy, solar

research, ultraviolet and visual astronomy, gamma ray astronomy, submm astronomy, and various research and development and commissioned research projects are reported. Funded research, the organization, the personnel and financial resources are described. Reports of the board, the science advisory board, and an executive summary are included. ESA

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N90-25022 Columbia Univ., New York, NY.
RADIATION-DRIVEN EVOLUTION OF LOW-MASS X RAY BINARIES Ph.D. Thesis
Marco Tavani 1989 231 p
Avail: Univ. Microfilms Order No. DA9005942

The evolution of binary systems containing weakly magnetized neutron stars can be significantly affected by the illumination of low-mass companions by x rays and, possibly, soft gamma-rays produced during accretion and post-accretion phases. A self-sustained mechanism may keep the radiation-induced mass transfer rate near the Eddington limit until the companion's mass m falls below a critical mass m(sub c) equal to a few hundredths of a solar mass. During the self-sustained evolutionary phase the companion can overflow its Roche lobe if the wind speed exceeds the effective escape velocity from the binary system. However, the self-sustained evolution can continue even when the companion no longer fills its Roche lobe, a state not achievable by binary evolution driven by stellar expansion or gravitational radiation. It is proposed that Cyg X-3 may be in this intermediate evolutionary phase with a solar composition degenerate companion with mass 0.01 solar mass is approximately or less than m is approximately or less than 0.03 solar mass underfilling its Roche lobe. After m drops below m(sub c), the x ray and gamma-ray luminosities are expected to fall by several orders of magnitude. If the rotational period of the spun-up neutron star is approximately 10(exp-3) sec, then sudden accretion turn-off occurs and millisecond pulsar becomes visible. After pulsar turn-on, disk material is blown away from the system by radiation pressure of the pulsar's strong kHz radiation. Electron-positron pairs produced by the msec pulsar, and accelerated to TeV energies by the large-amplitude em wave, can synchrotron radiate in the magnetic field of the kHz wave reflected near the companion. The resulting radiation may be effective in producing complete evaporation of the low-mass companion if its size has been kept close to its Roche lobe. The recently discovered eclipsing millisecond pulsar PSR 1957+20 confirms features of the proposed evolution which may ultimately result in isolated millisecond radiopulsars. Dissert. Abstr.

N90-25023 California Univ., Santa Cruz.
LARGE SCALE STRUCTURE AND MICROWAVE BACKGROUND ANISOTROPIES IN COSMOLOGICAL MODELS AND STELLAR PHOTOMETRY TECHNIQUES WITH THE WIDE FIELD/PLANETARY CAMERA OF THE HUBBLE SPACE TELESCOPE Ph.D. Thesis
Jon Andrew Holtzman 1989 189 p
Avail: Univ. Microfilms Order No. DA9003285

The first part of the dissertation presents calculations of microwave background anisotropies at various angular scales and of expected large scale bulk velocities and mass correlation functions for a variety of models which include baryons, radiation, cold dark matter (CDM), and massive and massless neutrinos. Free parameters include omega, the H(sub 0), the mass fractions of each component, and the initial conditions; nearly 100 different models are considered. Open and flat models with both adiabatic and isocurvature initial conditions are calculated for models without massive neutrinos. A set of flat models with both massive neutrinos and CDM with adiabatic initial conditions is also considered. Fitting functions for the mass transfer function and small angle radiation correlation function are provided for all of the models. A discussion of the evolution of the perturbations is presented. Results are compared with some recent observations of large scale velocities and limits on microwave background anisotropies. CDM and baryon models have difficulty satisfying observational limits, although they are not completely ruled out. Hybrid models with massive neutrinos and CDM satisfy current observational data. The second part of the dissertation is a discussion of stellar photometry reduction techniques for data to be obtained with the Wide Field/Planetary Camera (WF/PC) of the Hubble Space Telescope (HST). Detailed simulations are used to determine optimum techniques to use and to assess the expected accuracy of such techniques. Dissert. Abstr.

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

N90-25024 Iowa State Univ. of Science and Technology, Ames.
DYNAMIC AND PHOTOMETRIC EVOLUTIONARY MODELS OF TIDAL TAILS AND RIPPLES Ph.D. Thesis
John F. Wallin 1989 180 p
Avail: Univ. Microfilms Order No. DA9003576

The causes of star formation in tidal tails were investigated using a restricted three-body dynamical model in conjunction with a broad-band photometric evolutionary code. In these models, regions of compression form inside the disk and along the tital tail and tidal bridge. The effects these density changes have on the colors of the tidal features are examined with a broad-band photometric evolutionary code. A spiral galaxy population is synthesized and the effects of modest changes in the star formation rate are explored. Limits on the density changes needed to make detectable changes in the colors are calculated using a Schmidt (1959) law. These models suggest that the blue colors and knotty features observed in the tidal features of some galaxies result from increased rates of star formation induced by tidally produced density increases. Limitations of this model are discussed along with photometric evolutionary models based on the density evolution in the tails. The Lynds and Toomre (1976) interpretation of ring galaxies as the natural result of a nearly head-on collision between a disk galaxy and a companion galaxy has become widely accepted. Similarly, Quinn's (1984) interpretation of the shells in elliptical galaxies as the aftermath of the cannibalization of a low-mass companion was quite successful in accounting for the observations. Restricted three-body calculations of high inclination, low impact parameter encounters demonstrate that the shell-like ripples observed in a number of disk galaxies (cf. Schweizer and Seitzer 1988) can also be produced as collisional artifacts from internal oscillations much as in ring galaxies. However, in this case it is assumed that the target is an early-type disk with a sufficiently low gas fraction that recent star formation does not dominate the appearance of the disturbed disk. It should be emphasized that the models presented here are in a transient stage of an evolutionary sequence, whose outcome is most probably merger along the lines suggested by previous models of shells (Quinn 1988). Dissert. Abstr.

N90-25025# Ruhr Univ., Bochum (Germany, F.R.). Fakultaet fuer Physik und Astronomie.
DIFFERENTIATION OF THREE DIMENSIONAL MODELS OF THE ZODIACAL INTERPLANETARY DUST CLOUD FOR EXPERIMENTS WITH MICROMETEOROIDS DECAY DETECTORS ON THE SPACE STATION Ph.D. Thesis [DIE UNTERSCHEIDUNG DREIDIMENSIONALER MODELLE DER ZODIAKALEN INTERPLANETAREN STAUBWOLKE IM HINBLICK AUF EXPERIMENTE MIT RAUMFAHRZEUGGESTUETZTEN MIKROMETEORITENEINSCHLAGSDETEKTOREN]
Bernhard Kneissel 1988 187 p In GERMAN Sponsored by BMFT
(ETN-90-96488) Avail: NTIS HC A09/MF A01

The spatial distribution of the zodiacal dust is presented as a

result of inversion of the radiation or light integrales, and described by models from observations in visible and infrared spectra. The particle concentration and the flux densities are measured and the inclination is infrared, since the micrometeoroid detector Cosmic Dust Facility on the satellite platform space station does not take into account the vectors of the relative velocity. It is shown that all zodiacal particles cut across the ecliptic plane in its trajectory node so that the inclination distribution density can be estimated with consideration of the observation choice effects. ESA

N90-25026# Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematischen Gesamtfakulaet.
ANALYSIS OF ENERGY SPECTRA OF THE IONS IN THE COMA OF HALLEY'S COMET FOR THE EVALUATION OF THE PRODUCTION RATIO OF METHANE AND AMMONIA Ph.D. Thesis [ANALYSE VON ENERGIESPEKTREN DER IONEN IN DER KOMA DES HALLEY'SCHEN KOMETEN ZUR BESTIMMUNG DER PRODUKTIONSRATEN VON METHANE UND AMMONIAK]
Juergen Woweries 1989 102 p In GERMAN
(ETN-90-96489) Avail: NTIS HC A06/MF A01

The particle density, temperature and flow velocity of the ions are calculated from the energy spectra measured by neutral mass spectrometry; because of the high relative velocity between comet and sonde, the particle energy depends on mass. The evaluation process is based on a nonlinear regression. It is shown that in the internal coma two different areas exist, separated by a contact surface 4,600 km away from the comet core. A model of a comet atmosphere is calculated from the mass spectra from water, ammonia and methane which takes into account coma expansion, absorption of the ionizing radiation, photochemical and ion-molecule reactions. ESA

N90-25027# Goettingen Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftlichen Fachbereiche.
NONGRAVITATIONAL FORCES BY HALLEY'S COMET Ph.D. Thesis [NICHTGRAVITATIVE KRAEFTE BEIM HALLEYSCHEN KOMETEN]
Werner Landgraf 1988 187 p In GERMAN
(ETN-90-96491) Avail: NTIS HC A09/MF A01

The backward force of the gases escaping in the tail formation causes comets to have a self propelling motion. This was first calculated during the last comet appearance. Computer programs which allowed the estimation of comet, asteroid and moon trajectories, taking into account historical and current data, are described. ESA

N90-25028# Cologne Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftlichen Fakultaet.
INTERSTELLAR HCN, HNC AND HCO+: STABILITY EXPERIMENTS WITH ACOUSTOOPTIC SPECTROMETERS Ph.D. Thesis [INTERSTELLARES HCN, HNC UND HCO+ STABILITAETSUNTERSUCHUNGEN MIT DEN AKUSTO-OPTISCHEN SPEKTROMETERN]
Alexander Piciorgros 1988 101 p In GERMAN Sponsored by DFG
(ETN-90-96495) Avail: NTIS HC A06/MF A01

Astronomical measurements realized with the KOSMA (Cologne Observatory for Submillimeter Astronomy) telescope are presented. The acoustooptic spectrometers were used as backends, and heterodyne-sensibility system was used as front-end in the frequency area 75 to 116 GHz. Measurements were realized in total power as well as in switched-power-mode. The influence of the speckle on the integration behavior of the acoustooptic spectrometer is explained by a contribution to the noise of a measurement. It is shown that this instrument is perfect for long-time integrations and mapping. ESA

N90-25029*# Los Alamos National Lab., NM. Space Astronomy and Astrophysics Group.
SYNTHETIC SPECTRA OF ACCRETION DISKS IN DQ HER BINARIES
Christopher W. Mauche, Guy S. Miller, John C. Raymond, and Frederick K. Lamb (Illinois Univ., Urbana-Champaign.) 1989 10 p Presented at the 11th North American Workshop on CV's and LMXRV's, Santa Fe, NM, 9-13 Oct. 1989
(Contract NAGw-1583; W-7405-eng-36; NSF PHY-86-00377)
(NASA-CR-186837; NAS 1.26:186837; DE90-011956; LA-UR-90-1495; CONF-8910381-2) Avail: NTIS HC A02/MF A01 CSCL 03B

The effect of the stellar magnetic field on the spectrum of the disk is explored by comparing synthesized disk spectra to the observed ultraviolet spectrum of the well-studied DQ Her binary GK Per. The parameterized disk-magnetosphere interaction models of Miller and Lamb is used to calculate the radius of the inner edge of the disk and the local heating rate within the disk as a function of radius. With appropriate choices of parameters, these models can describe the models of Ghosh and Lamb and Wang. Once the local heating rate is determined, an effective temperature was assigned to each of a series of disk annuli. The disk spectrum is then calculated by summing the flux contributed by each annulus, assuming that each annulus has the same spectrum as a main-sequence star with the assigned effective temperature. DOE

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N90-25030*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
GEOSCIENCE AND A LUNAR BASE: A COMPREHENSIVE PLAN FOR LUNAR EXPLORATION
G. Jeffrey Taylor, ed. and Paul D. Spudis, ed. (Geological Survey, Flagstaff, AZ.) Washington Apr. 1990 76 p Workshop held in Houston, TX, 25-26 Aug. 1988
(NASA-CP-3070; S-603; NAS 1.55:3070) Avail: NTIS HC A05/MF A01 CSCL 03B

This document represents the proceedings of the Workshop on Geoscience from a Lunar Base. It describes a comprehensive plan for the geologic exploration of the Moon. The document begins by explaining the scientific importance of studying the Moon and outlines the many unsolved problems in lunar science. Subsequent chapters detail different, complementary approaches to geologic studies: global surveys, including orbiting spacecraft such as Lunar Observer and installation of a global geophysical network; reconnaissance sample return mission, by either automated rovers or landers, or by piloted forays; detailed field studies, which involve astronauts and teleoperated robotic field geologists. The document then develops a flexible scenario for exploration and sketches the technological developments needed to carry out the exploration scenario. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

No abstracts in this category.

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N90-25031*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
IMPROVED MODEL FOR SOLAR COSMIC RAY EXPOSURE IN MANNED EARTH ORBITAL FLIGHTS
John W. Wilson, John E. Nealy, William Atwell, Francis A. Cucinotta (Rockwell International Corp., Houston, TX.), Judy L. Shinn, and Lawrence W. Townsend Washington Jun. 1990 14 p
(NASA-TP-2987; L-16759; NAS 1.60:2987) Avail: NTIS HC A03/MF A01 CSCL 03B

A calculational model is derived for use in estimating Solar cosmic ray exposure to critical body organs in low-Earth orbit at the center of a large spherical shield of fixed thickness. The effects of the Earth's geomagnetic field and the astronauts' self-shielding are evaluated explicitly. The geomagnetic field model is an approximate tilted eccentric dipole with geomagnetic storms represented as a uniform-impressed field. The storm field is related to the planetary geomagnetic index K(sub p). The code is applied to the Shuttle geometry using the Shuttle mass distribution surrounding two locations on the flight deck. The Shuttle is treated as pure aluminum and the astronaut as soft tissue. Short-term, average fluence over a single orbit is calculated as a function of the location of the lines of nodes or long-term averages over all lines of nodes for a fixed inclination. Author

N90-25032 California Univ., Santa Cruz.
MULTIWAVELENGTH CONSTRAINTS ON GAMMA-RAY BURST SOURCES Ph.D. Thesis
Dieter H. B. Hartmann 1989 266 p
Avail: Univ. Microfilms Order No. DA9003284

Cosmic gamma-ray bursts remain a puzzle since their discovery about two decades ago. No quiescent counterpart of a gamma-ray burst source has been unambiguously identified in any wavelength band and the angular distribution of sources in the sky is isotropic and indicates no association with any galactic or extragalactic features, thus leaving the burster distance scale undetermined. There is observational evidence that gamma-ray bursts are associated with neutron stars in the general vicinity of the galaxy. Lacking unambiguous counterpart identification at low energies, we attempt to determine the burster distance scale using statistical tools. The angular and brightness distribution of gamma-ray bursts are analyzed. Quantitative estimates of the large-scale isotropy and small-scale angular clustering are used to constrain current detector sampling depths for extragalactic models and local models involving neutron stars. The distribution of neutron stars is calculated by using a realistic model of the mass distribution in the Galaxy and integrating stellar orbits using initial conditions obtained from radio observations of pulsars. Based on the statistical analysis it is concluded that gamma-ray burst sources are either very near or very far. Statistical analysis of data expected from the Gamma Ray observatory could produce evidence in favor of a galactic origin of gamma-ray burst, but that cannot replace optical identification of a gamma-ray burst counterpart. At low energies, counterparts may be detected in quiescence or by low energy emission simultaneous with the gamma-ray outburst. Evidence exists that gamma-ray burst might be accompanied by optical emission. The physics of the thermal cyclotron reprocessing model for these optical flashes is presented and it is discussed how future observations of optical transients could be used as a diagnostic tool to help understand the nature of gamma-ray bursts. Deep CCD surveys of the fields surrounding the recurrent optical transient source OTS 1809+314 and the variable star FY Aql inside the error box of GB790331 are also discussed.

Dissert. Abstr.

N90-25033# California Univ., Berkeley. Lawrence Berkeley Lab. Physics Div.
LOW-FREQUENCY MEASUREMENTS OF THE CMB (COSMIC MICROWAVE BACKGROUND) SPECTRUM
A. Kogut, M. Bensadoun, G. DeAmici, S. Levin, M. Limon, G. Smoot, G. Sironi, M. Bersanelli, and G. Bonelli (Consiglio Nazionale delle Ricerche, Milan, Italy) Oct. 1989 5 p Presented at the Workshop on Astrophysics in Antarctica, Newark, NJ, 8-10 Jun. 1989
(Contract DE-AC03-76SF-00098; NSF DPP-87-16548)
(DE90-011589; LBL-28024; CONF-8906234-2) Avail: NTIS HC A01/MF A01

As part of an extended program to characterize the spectrum of the cosmic microwave background (CMB) at low frequencies, multiple measurements were performed from a high-altitude site in California. On average, these measurements suggest a CMB temperature slightly lower than measurements at higher frequencies. Atmospheric conditions and the encroachment of civilization are now significant limitations from the present observing site. In November 1989, new measurements will be made from the South Pole Amnudsen-Scott Station at frequencies 0.82 1.5, 2.5, 3.8, 7.5, and 90 GHz. Recent measurements are discussed and improvements indicated from a polar observing site. DOE

99 GENERAL

N90-25034*# Old Dominion Univ., Norfolk, VA.
NASA/AMERICAN SOCIETY FOR ENGINEERING EDUCATION (ASEE) SUMMER FACULTY FELLOWSHIP PROGRAM 1989
Surendra N. Tiwari, comp. Sep. 1989 184 p Program held in Hampton, VA, 5 Jun. - 11 Aug. 1989
(Grant NGT-47-003-029)
(NASA-CR-181894; NAS 1.26:181894) Avail: NTIS HC A09/MF A02 CSCL 05I

Since 1964, NASA has supported a program of summer faculty fellowships for engineering and science educators. The objectives are: to further the professional knowledge of qualified engineering and science faculty; to stimulate and exchange ideas between participants and NASA; to enrich and refresh the research and teachning activities of participants' institutions; and to contribute to the research objectives of the NASA center. College or university faculty members will be appointed as Research Fellows to spend 10 weeks in cooperative research and study at the NASA Langley Research Center. The Fellow will devote approximately 90 percent of the time to a research problem and the remaining time to a study program. The study program will consist of lecture and seminars on topics of interest or that are directly relevant to the Fellows' research topic. For individual titles, see N90-25035 through N90-25071.

N90-25035*# Norfolk State Univ., VA.
GROUND EVALUATION OF SEEDING AN IN-FLIGHT WINGTIP VORTEX USING INFRARED IMAGING FLOW VISUALIZATION TECHNIQUE **c02**
Ted Akinyanju *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 38-40 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 01A

An experimental simulation of an in-flight wingtip vortical flow visualization technique uses infrared imaging to observe strong and concentrated vortices. This experiment is phase 1 of a two-phase infrared evaluation program. The system includes a vortex generator (model 320 Vortec Vortex Tube) which generates the required vortex. The mouth of the unit is mounted close to the free end of a half-inch diameter, sixteen and a half foot long stainless steel tubing (sized after tubing currently installed in the wings of an experimental Beechcraft Sundowner 180 aircraft). Dichloro difluoromethane (Freon-12) is entrained into the generated vortex. A breakdown of the vortices is indicated by the rapid

diffusion and the resulting pattern is tracked using the infrared imager and video systems. Flow rates (volume and mass) are estimated at the laboratory and proposed flight conditions. The nominal flight altitude is expected to be 2500 feet. Author

N90-25036*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
INCORPORATION OF A PROGRESSIVE FAILURE ANALYSIS METHOD IN THE CSM TESTBED SOFTWARE SYSTEM c61
Robert T. Arenburg *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 41-45 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 09B

Analysis of the postbuckling behavior of composite shell structures pose many difficult and challenging problems in the field of structural mechanics. Current analysis methods perform well for most cases in predicting the postbuckling response of undamaged components. To predict component behavior accurately at higher load levels, the analysis must include the effects of local material failures. The CSM testbed software system is a highly modular structural analysis system currently under development at Langley Research Center. One of the primary goals of the CSM testbed is to provide a software environment for the development of advanced structural analysis methods and modern numerical methods which will exploit advanced computer architecture such as parallel-vector processors. Development of a progressive failure analysis method consists of the design and implementation of a processor which will perform the ply-level progressive failure analysis and the development of a geometrically nonlinear analysis procedure which incorporates the progressive failure processor. Regarding the development of the progressive failure processor, two components are required: failure criteria and a degradation model. For the initial implementation, the failure criteria of Hashin will be used. For a matrix failure which typically indicates the development of transverse matrix cracks, the ply properties will be degraded. Work to date includes the design of the progressive failure analysis processor and initial plans for the controlling geometrically nonlinear analysis procedure. The implementation of the progressive failure analysis has begun. Access to the model database and the Hashin failure criteria are completed. Work is in progress on the input/output operations for the processor related data and the finite element model updating procedures. In total the progressive failure processor is approximately one-third complete. Author

N90-25037*# Hampton Univ., VA. Airway Science Program.
AUTOMATIC SPEECH RECOGNITION IN AIR-GROUND DATA LINK Abstract Only c32
Herbert B. Armstrong *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 46-47 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 17B

In the present air traffic system, information presented to the transport aircraft cockpit crew may originate from a variety of sources and may be presented to the crew in visual or aural form, either through cockpit instrument displays or, most often, through voice communication. Voice radio communications are the most error prone method for air-ground data link. Voice messages can be misstated or misunderstood and radio frequency congestion can delay or obscure important messages. To prevent proliferation, a multiplexed data link display can be designed to present information from multiple data link sources on a shared cockpit display unit (CDU) or multi-function display (MFD) or some future combination of flight management and data link information. An aural data link which incorporates an automatic speech recognition (ASR) system for crew response offers several advantages over visual displays. The possibility of applying ASR to the air-ground data link was investigated. The first step was to review current efforts in ASR applications in the cockpit and in air traffic control and evaluated their possible data line application. Next, a series of preliminary research questions is to be developed for possible future collaboration. Author

N90-25038*# University of Central Michigan, Mount Pleasant. Dept. of Computer Science.
A FEW MODELING AND RENDERING TECHNIQUES FOR COMPUTER GRAPHICS AND THEIR IMPLEMENTATION ON ULTRA HARDWARE Abstract Only c61
Hari Bidasaria *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 48-49 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 09B

Ultra network is a recently installed very high speed graphic hardware at NASA Langley Research Center. The Ultra Network interfaced to Voyager through its HSX channel is capable of transmitting up to 800 million bits of information per second. It is capable of displaying fifteen to twenty frames of precomputed images of size 1024 x 2368 with 24 bits of color information per pixel per second. Modeling and rendering techniques are being developed in computer graphics and implemented on Ultra hardware. A ray tracer is being developed for use at the Flight Software and Graphic branch. Changes were made to make the ray tracer compatible with Voyager. Author

N90-25039*# Jackson State Univ., MS. Dept. of Technology.
STRUT-NODE JOINT CONJUGATES FOR THE ASSEMBLY OF SEMI-PERMANENT OR REUSABLE TRUSS STRUCTURES c39
W. V. Brewer *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 50-55 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20K

When strut and node components are used for truss construction an assembly problem occurs if a strut must be fitted between nodes whose separation distance is either closer or farther than the design intended. This condition is the result of normal dimensional variations that occur in any manufacturing process. In such circumstances two actions would permit continued assembly: change the effective strut length, and move the nodes. Assuming continued assembly is the most attractive alternative, attention is focused on accomplishing these actions as part of the assembly process. Author

N90-25040*# State Univ. of New York, Brockport. Dept. of Earth Sciences.
A QUANTITATIVE TECHNIQUE TO ESTIMATE MICROBURST WIND SHEAR HAZARD TO AIRCRAFT c47
Gregory P. Byrd *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 56-59 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 04B

Low-altitude microburst wind shear encounters can significantly affect aircraft performance during approach or takeoff. Over the past 25 years, hazardous wind shear was a contributing factor in over two dozen commercial airline accidents in which there were over 500 fatalities. NASA, the FAA, and the National Center for Atmospheric Research were involved in the design and testing of various sensors to detect the hazard. Among the sensors being tested are the ground-based Terminal Doppler Weather Radar (TDWR) and airborne Doppler radar and LIDAR systems. While these sensor systems do measure horizontal wind shear, they do not adequately account for the vertical wind, which is a key component of the microburst hazard to the aircraft. A technique is defined to estimate aircraft hazard from the combined effects of horizontal and vertical winds, given only horizontal wind information. Author

N90-25041*# Stonehill Coll., North Easton, MA. Dept. of Mathematics and Computer Science.
FROM WHERE THEY LOOK TO WHAT THEY THINK: DETERMINING CONTROLLER COGNITIVE STRATEGIES FROM OCULOMETER SCANNING DATA c53
Steven Cushing *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 60-66 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 05I

The behavior and cognition of air traffic controllers from oculometer scanning data already obtained for another purpose was studied. There was very little work done to develop models of air traffic controllers, much of what was done was done at Langley. One aim of developing such models is to use them as the basis of decision-support or expert-system tools to assist controllers in their tasks. Such tools are more likely to be effective if they incorporate the strategies that controllers actually use, rather than steering them in what might be felt to be unnatural directions. Author

N90-25042*# New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
STRUCTURAL ZOOMING RESEARCH AND DEVELOPMENT OF AN INTERACTIVE COMPUTER GRAPHICAL INTERFACE FOR STRESS ANALYSIS OF CRACKS c39
Walter Gerstle *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 67-68 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20K

Engineering problems sometimes involve the numerical solution of boundary value problems over domains containing geometric feature with widely varying scales. Often, a detailed solution is required at one or more of these features. Small details in large structures may have profound effects upon global performance. Conversely, large-scale conditions may effect local performance. Many man-hours and CPU-hours are currently spent in modeling such problems. With the structural zooming technique, it is now possible to design an integrated program which allows the analyst to interactively focus upon a small region of interest, to modify the local geometry, and then to obtain highly accurate responses in that region which reflect both the properties of the overall structure and the local detail. A boundary integral equation analysis program, called BOAST, was recently developed for the stress analysis of cracks. This program can accurately analyze two-dimensional linear elastic fracture mechanics problems with far less computational effort than existing finite element codes. An interactive computer graphical interface to BOAST was written. The graphical interface would have several requirements: it would be menu-driven, with mouse input; all aspects of input would be entered graphically; the results of a BOAST analysis would be displayed pictorially but also the user would be able to probe interactively to get numerical values of displacement and stress at desired locations within the analysis domain; the entire procedure would be integrated into a single, easy to use package; and it would be written using calls to the graphic package called HOOPS. The program is nearing completion. All of the preprocessing features are working satisfactorily and were debugged. The postprocessing features are under development, and rudimentary postprocessing should be available by the end of the summer. The program was developed and run on a VAX workstation, and must be ported to the SUN workstation. This activity is currently underway. Author

N90-25043*# Washington Univ., Seattle. Dept. of Aeronautics and Astronautics.
CONCEPTUAL DESIGN FOR AEROSPACE VEHICLES Abstract Only c05
Louis B. Gratzer *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 71-72 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 01C

The designers of aircraft and more recently, aerospace vehicles have always struggled with the problems of evolving their designs to produce a machine which would perform its assigned task(s) in some optimum fashion. Almost invariably this involved dealing with more variables and constraints than could be handled in any computationally feasible way. With the advent of the electronic digital computer, the possibilities for introducing more variable and constraints into the initial design process led to greater expectations for improvement in vehicle (system) efficiency. The creation of the large scale systems necessary to achieve optimum designs has, for many reason, proved to be difficult. From a technical standpoint, significant problems arise in the development of satisfactory algorithms for processing of data from the various technical disciplines in a way that would be compatible with the complex optimization function. Also, the creation of effective optimization routines for multi-variable and constraint situations which could lead to consistent results has lagged. The current capability for carrying out the conceptual design of an aircraft on an interdisciplinary bases was evaluated to determine the need for extending this capability, and if necessary, to recommend means by which this could be carried out. Based on a review of available documentation and individual consultations, it appears that there is extensive interest at Langley Research Center as well as in the aerospace community in providing a higher level of capability that meets the technical challenges. By implication, the current design capability is inadequate and it does not operate in a way that allows the various technical disciplines to participate and cooperately interact in the design process. Based on this assessment, it was concluded that substantial effort should be devoted to developing a computer-based conceptual design system that would provide the capability needed for the near-term as well as framework for development of more advanced methods to serve future needs. Author

N90-25044*# Bethune-Cookman Coll., Daytona Beach, FL. Div. of Science and Mathematics.
A 3D VISUALIZATION SYSTEM FOR MOLECULAR STRUCTURES Abstract Only c72
Terry J. Green *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 73 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20H

The properties of molecules derive in part from their structures. Because of the importance of understanding molecular structures various methodologies, ranging from first principles to empirical technique, were developed for computing the structure of molecules. For large molecules such as polymer model compounds, the structural information is difficult to comprehend by examining tabulated data. Therefore, a molecular graphics display system, called MOLDS, was developed to help interpret the data. MOLDS is a menu-driven program developed to run on the LADC SNS computer systems. This program can read a data file generated by the modeling programs or data can be entered using the keyboard. MOLDS has the following capabilities: draws the 3-D representation of a molecule using stick, ball and ball, or space filled model from Cartesian coordinates, draws different perspective views of the molecule; rotates the molecule on the X, Y, Z axis or about some arbitrary line in space, zooms in on a small area of the molecule in order to obtain a better view of a specific region; and makes hard copy representation of molecules on a graphic printer. In addition, MOLDS can be easily updated and readily adapted to run on most computer systems. Author

N90-25045*# Eureka Coll., IL. Dept. of Mathematics and Physics.
STABILITY OF LASER OSCILLATOR SYSTEMS c36
Joseph C. Hafele *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 74-75 (For primary document

see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20E

One of the goals of the Stanford University-NASA Laser-In-space Technology Experiment (SUNLITE) program is to develop ultrastable optical frequency oscillators that can lead to high resolution time standards and ultimately standard clocks. During the past year or two there was remarkable progress towards achieving in the laboratory the fundamental quantum limits for the frequency stability of nonplanar ring oscillator (NPRO) lasers. The quantum theoretical limits for laser oscillator stability are reviewed, measured stability levels compared, and some applications of such ultrastable laser oscillator systems suggested. Author

N90-25046*# Tennessee Univ., Knoxville. Dept. of Chemical Engineering.
MORPHOLOGICAL CONTROL OF INTER-PENETRATING POLYMER NETWORKS Abstract Only c27
Marion Hansen *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 76 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 11C

Synthetic organic polymer chemistry has been successful in producing composition of matter with thermal oxidation stability and progressively higher glass transition temperatures. In part, this was done by increasing the steric-hindrance of moieties in the chain of a macromolecule. The resulting polymers are usually quite insoluble and produce molten polymers of very high viscosities. These types of polymers are not easily processed into graphite fiber prepregs by melt or solution impregnation methods. Hence, a technological need exists to produce new knowledge of how to produce polymer-fiber composites from this class of polymers. The concept of freeze drying amic-acid prepolymers with reactive thermoplastic was proposed as a research topic for the ASEE/NASA Summer Faculty Program of 1989 as a means of producing polymer-fiber composites. This process scheme has the thermodynamic attribute that the magnitude of phase separation due to differences in solubility of two organic constituents in solution will be greatly reduced by removing a solvent not by evaporation but by sublimation. Progress to date on evaluating this polymer processing concept is briefly outlined. Author

N90-25047*# Virginia State Univ., Petersburg. Dept. of Physics.
CHARACTERIZATION OF A Ho:Tm:Cr:YAG LASER WITH A Cr:GSAG LASER AS PUMPING SOURCE Abstract Only c36
George W. Henderson *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 77-78 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20E

Rare earth lasers were in existance since the first laser was developed. The primary lasing elements for the class of lasers in the infrared was neodymium and chromium. However, the need for eye safe lasers in the mid-infrared range has prompted an enormous amount of research to the use of other elements. Holmium was investigated extensively as the source of infrared radiation for atmospheric research as well as medical research. The results and procedure are briefly discussed. Author

N90-25048*# Oregon State Univ., Corvallis. Dept. of Civil Engineering.
DYNAMIC ANALYSIS OF FLEXIBLE MULTIBODY STRUCTURES Abstract Only c39
Alan G. Hernried *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 79-80 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20K

A system composed of several interconnected elastic components that may experience large angular motion relative to each other during operation is referred to as a flexible multibody structure. Several formulations were proposed for the determination of the dynamic response of controlled flexible multibody structures. In general, these formulations consist of superposing elastic deformations of the component body onto the large rigid body motion of the component. It was shown that this particular methodology for combining linear structural deformations with nonlinear kinematics can lead to erroneous response predictions when either the beam member is very flexible or the rotational speed is high. In addition, previous formulations introduce constraint equations to define the interrelations among system components. This approach increases the number of equations that must be solved, and may result in contraint violation when numerical error accumulates during the integration process. In order to overcome the difficulties, a new approach was suggested. The approach is essentially a finite element formulation which takes advantage of the fact that many multibody structures are joint dominated. The Large Angle Transient Dynamic Analysis (LATDYN) program for clarity of documentation, ease of use, user friendliness, modeling generality, and accuracy of results was evaluated. This required gaining a working familiarity with the code and performing several case studies. Author

N90-25049*# Wichita State Univ., KS. Dept. of Aerospace Engineering.
DEVELOPMENT OF A FINITE ELEMENT BASED DELAMINATION ANALYSIS FOR LAMINATES SUBJECT TO EXTENSION, BENDING, AND TORSION Abstract Only c24
Steven J. Hooper *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 81-83 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 11D

Delamination is a common failure mode of laminated composite materials. This type of failure frequently occurs at the free edges of laminates where singular interlaminar stresses are developed due to the difference in Poisson's ratios between adjacent plies. Typically the delaminations develop between 90 degree plies and adjacent angle plies. Edge delamination has been studied by several investigators using a variety of techniques. Recently, Chan and Ochoa applied the quasi-three-dimensional finite element model to the analysis of a laminate subject to bending, extension, and torsion. This problem is of particular significance relative to the structural integrity of composite helicopter rotors. The task undertaken was to incorporate Chan and Ochoa's formulation into a Raju Q3DG program. The resulting program is capable of modeling extension, bending, and torsional mechanical loadings as well as thermal and hygroscopic loadings. The addition of the torsional and bending loading capability will provide the capability to perform a delamination analysis of a general unsymmetric laminate containing four cracks, each of a different length. The solutions obtained using this program are evaluated by comparing them with solutions from a full three-dimensional finite element solution. This comparison facilitates the assessment of three dimensional affects such as the warping constraint imposed by the load frame grips. It wiso facilitates the evaluation of the external load representation employed in the Q3D formulation. Finally, strain energy release rates computed from the three-dimensional results are compared with those predicted using the quasi-three-dimensional formulation. Author

N90-25050*# Elizabeth City State Univ., NC. Dept. of Mathematics and Computer Science.
THE IMPLEMENTATION OF THE GRAPHICS OF PROGRAM EAGLE: A NUMERICAL GRID GENERATION CODE ON NASA LANGLEY SNS COMPUTER SYSTEM Abstract Only c61
Johnny L. Houston *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 84-85 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 09B

Program EAGLE (Eglin Arbitrary Geometry Implicit Euler) Numerical Grid Generation System is a composite (multi-block) algebraic or elliptic grid generation system designed to discretize the domain in and/or around any arbitrarily shaped three

dimensional regions. This system combines a boundary conforming surface generation scheme and includes plotting routines designed to take full advantage of the DISSPLA Graphics Package (Version 9.0). Program EAGLE is written to compile and execute efficiently on any Cray machine with or without solid state disk (SSD) devices. Also, the code uses namelist inputs which are supported by all Cray machines using the FORTRAN compiler CFT77. The namelist inputs makes it easier for the user to understand the inputs and operation of Program EAGLE. EAGLE's numerical grid generator is constructed in the following form: main program, EGG (executive routine); subroutine SURFAC (surface generation routine); subroutine GRID (grid generation routine); and subroutine GRDPLOT (grid plotting routines). The EAGLE code was modified to use on the NASA-LaRC SNS computer (Cray 2S) system. During the modification a conversion program was developed for the output data of EAGLE's subroutine GRID to permit the data to be graphically displayed by IRIS workstations, using Plot3D. The code of program EAGLE was modified to make operational subroutine GRDPLOT (using DI-3000 Graphics Software Packages) on the NASA-LaRC SNS Computer System. How to implement graphically, the output data of subroutine GRID was determined on any NASA-LaRC graphics terminal that has access to the SNS Computer System DI-300 Graphics Software Packages. A Quick Reference User Guide was developed for the use of program EAGLE on the NASA-LaRC SNS Computer System. One or more application program(s) was illustrated using program EAGLE on the NASA LaRC SNS Computer System, with emphasis on graphics illustrations. Author

N90-25051*# Maine Univ., Orono. Dept. of Mathematics.
AN ANALYTIC STUDY OF NONSTEADY TWO-PHASE LAMINAR BOUNDARY LAYER AROUND AN AIRFOIL Abstract Only **c34**
Yu-Kao Hsu *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 86-88 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20D

Recently, NASA, FAA, and other organizations have focused their attention upon the possible effects of rain on airfoil performance. Rhode carried out early experiments and concluded that the rain impacting the aircraft increased the drag. Bergrum made numerical calculation for the rain effects on airfoils. Luers and Haines did an analytic investigation and found that heavy rain induces severe aerodynamic penalties including both a momentum penalty due to the impact of the rain and a drag and lift penalty due to rain roughening of the airfoil and fuselage. More recently, Hansman and Barsotti performed experiments and declared that performance degradation of an airfoil in heavy rain is due to the effective roughening of the surface by the water layer. Hansman and Craig did further experimental research at low Reynolds number. E. Dunham made a critical review for the potential influence of rain on airfoil performance. Dunham et al. carried out experiments for the transport type airfoil and concluded that there is a reduction of maximum lift capability with increase in drag. There is a scarcity of published literature in analytic research of two-phase boundary layer around an airfoil. Analytic research is being improved. The following assumptions are made: the fluid flow is non-steady, viscous, and incompressible; the airfoil is represented by a two-dimensional flat plate; and there is only a laminar boundary layer throughout the flow region. The boundary layer approximation is solved and discussed. Author

N90-25052*# South Carolina State Coll., Orangeburg. Dept. of Civil and Mechanical Engienering.
FATIGUE ANALYSIS OF MINI-MAST SPACE TRUSS Abstract Only **c39**
Shoi Y. Hwang *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 89-90 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20K

The functional, structural adequacy of a 20 meter long generic space truss (Mini-Mast), subjected to fatigue loading, was examined with respect to the failure modes which are most likely to occur during services. The space truss is made of thin-walled tubes having unidirectional, zero degree layups of Celanese G50 graphite fibers/Narmco 5217 epoxy composites. The approach used to investigate the most probable failure mode of the truss under fatigue loading is to determine the stress level, including the types of stress, in the member first, then followed by failure mode analysis based on the stress level just determined. To begin, an approximate beam-parameter truss (BPT) model is analyzed first, followed by a detailed analysis of the truss using a finite element model (FEM) run with NASTRAN code. The response results of the BPT model are used to compare FEM results and to check any major deviation of trend derived from the FEM. The purpose of the work was to search available fatigue data of the tube material, to conduct approximate dynamical stress analysis of the BPT model, to run detailed dynamical stress analysis of the FEM model using NASTRAN code, and to predict the fatigue life of the truss member based on limited fatigue data. Author

N90-25053*# Mercer Univ., Macon, GA. Dept. of Electrical and Computer Engineering.
AFE DYNAMIC EFFECTS IN INHOMOGENEOUS PLASMAS Abstract Only **c75**
Jeng-Nan Juang *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 91-92 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20I

The Microwave Reflectometer Ionization Sensor (MRIS) is an instrument on the Aeroassist Flight Experiment (AFE) satellite which will be deployed from the space shuttle. The flow characteristic around a hypersonic bluff reentry vehicle will be measured by the AFE. The general mission of the MRIS is to measure the electron density within the range from 10(exp12) to 10(exp 15) electrons per cu cm and determine the distance to the location of each measured from the surface of the aerobrake. These measurements will be compared with prior aerothermodynamic computer code predictions. Since a knowledge of plasma dynamic effects is important for MRIS design and post flight analysis, it is of interest to consider any possibility of plasma dynamic effects and especially in inhomogeneous plasmas. Of particular interest is the need to study plasma dynamic effects that may emerge from a flow field stationary state that was determined without regard to electric or magnetic fields. Author

N90-25054*# Richmond Univ., VA. Dept. of Chemistry.
CHARACTERIZATION OF THE SURFACES OF PLATINUM/TIN OXIDE BASED CATALYSTS BY FOURIER TRANSFORM SPECTROSCOPY (FTIR) Abstract Only **c25**
Joseph T. Keiser *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 93-94 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 07D

The Laser Atmospheric Wind Sounder (LAWS) Program has as one of its goals the development of a satellite based carbon dioxide laser for making wind velocity measurements. The specifications for this laser include the requirement that the laser operate at a repetition rate of 10 Hertz continuously for three years. Earth-based carbon dioxide lasers can operate for only a short time on a single charge of gas because the lasing action causes the CO2 to break down into CO and O2. Therefore, earth-based CO2 lasers are generally operated in a flow through mode in which the spent gas is continually exhausted and fresh gas is continually added. For a satellite based system, however, a recirculation system is desired because it is not practical to send up extra tanks of CO2. A catalyst which could enable a recirculating CO2 laser to function continuously for three years needs to be developed. In the development of a catalyst system there are many variables. Obviously, not all possible formulations can be tested for three years, therefore, an accurate model which is based on the reaction mechanism is needed. The construction

of a multistep reaction mechanism is similar to the construction of a jigsaw puzzle. Different techniques each supply a piece of the puzzle and the researcher must put the pieces together. Transmission infrared spectroscopy was shown to be very useful in supplying some of the information needed to elucidate reaction mechanisms. The purpose was to see what kind of information might be obtained about the NASA catalyst using infrared absorption spectroscopy. Approximately 200 infrared spectra of the prototype Pt/tin oxide catalyst and its precursor components are observed under a variety of different conditions. The most significant observations are summarized. Author

N90-25055*# College of William and Mary, Williamsburg, VA. Dept. of Mathematics.

MINIMIZING DISTORTION AND INTERNAL FORCES IN TRUSS STRUCTURES BY SIMULATED ANNEALING c39

Rex K. Kincaid *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 95-102 (For primary document see N90-25034 18-99)

Avail: NTIS HC A09/MF A02 CSCL 20K

Inaccuracies in the length of members and the diameters of joints of large truss reflector backup structures may produce unacceptable levels of surface distortion and member forces. However, if the member lengths and joint diameters can be measured accurately it is possible to configure the members and joints so that root-mean-square (rms) surface error and/or rms member forces is minimized. Following Greene and Haftka (1989) it is assumed that the force vector f is linearly proportional to the member length errors e(sub M) of dimension NMEMB (the number of members) and joint errors e(sub J) of dimension NJOINT (the number of joints), and that the best-fit displacement vector d is a linear function of f. Let NNODES denote the number of positions on the surface of the truss where error influences are measured. The solution of the problem is discussed. To classify, this problem was compared to a similar combinatorial optimization problem. In particular, when only the member length errors are considered, minimizing d(sup 2)(sub rms) is equivalent to the quadratic assignment problem. The quadratic assignment problem is a well known NP-complete problem in operations research literature. Hence minimizing d(sup 2)(sub rms) is is also an NP-complete problem. The focus of the research is the development of a simulated annealing algorithm to reduce d(sup 2)(sub rms). The plausibility of this technique is its recent success on a variety of NP-complete combinatorial optimization problems including the quadratic assignment problem. A physical analogy for simulated annealing is the way liquids freeze and crystallize. All computational experiments were done on a MicroVAX. The two interchange heuristic is very fast but produces widely varying results. The two and three interchange heuristic provides less variability in the final objective function values but runs much more slowly. Simulated annealing produced the best objective function values for every starting configuration and was faster than the two and three interchange heuristic. Author

N90-25056*# Elizabeth City State Univ., NC. Dept. of Technology.

A USER-FRIENDLY, MENU-DRIVEN, LANGUAGE-FREE LASER CHARACTERISTICS CURVES GRAPHING PROGRAM FOR DESK-TOP IBM PC COMPATIBLE COMPUTERS c61

Glenn Klutz *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 103-104 (For primary document see N90-25034 18-99)

Avail: NTIS HC A09/MF A02 CSCL 09B

A facility was established that uses collected data and feeds it into mathematical models that generate improved data arrays by correcting for various losses, base line drift, and conversion to unity scaling. These developed data arrays have headers and other identifying information affixed and are subsequently stored in a Laser Materials and Characteristics data base which is accessible to various users. The two part data base: absorption - emission spectra and tabulated data, is developed around twelve laser models. The tabulated section of the data base is divided into several parts: crystalline, optical, mechanical, and thermal properties; aborption and emission spectra information; chemical name and formulas; and miscellaneous. A menu-driven, language-free graphing program will reduce and/or remove the requirement that users become competent FORTRAN programmers and the concomitant requirement that they also spend several days to a few weeks becoming conversant with the GEOGRAF library and sequence of calls and the continual refreshers of both. The work included becoming thoroughly conversant with or at least very familiar with GEOGRAF by GEOCOMP Corp. The development of the graphing program involved trial runs of the various callable library routines on dummy data in order to become familiar with actual implementation and sequencing. This was followed by trial runs with actual data base files and some additional data from current research that was not in the data base but currently needed graphs. After successful runs, with dummy and real data, using actual FORTRAN instructions steps were undertaken to develop the menu-driven language-free implementation of a program which would require the user only know how to use microcomputers. The user would simply be responding to items displayed on the video screen. To assist the user in arriving at the optimum values needed for a specific graph, a paper, and pencil check list was made available to use on the trial runs. Author

N90-25057*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.

EXTENSION-TORSION COUPLING BEHAVIOR OF ADVANCED COMPOSITE TILT-ROTOR BLADES c05

J. B. Kosmatka *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 105-110 (For primary document see N90-25034 18-99)

Avail: NTIS HC A09/MF A02 CSCL 01C

An analytic model was developed to study the extension-bend-twist coupling behavior of an advanced composite helicopter or tilt-rotor blade. The outer surface of the blade is defined by rotating an arbitrary cross section about an initial twist axis. The cross section can be nonhomogeneous and composed of generally anisotropic materials. The model is developed based upon a three dimensional elasticity approach that is recast as a coupled two-dimensional boundary value problem defined in a curvilinear coordinate system. Displacement solutions are written in terms of known functions that represent extension, bending, and twisting and unknown functions for local cross section deformations. The unknown local deformation functions are determined by applying the principle of minimum potential energy to the discretized two-dimensional cross section. This is an application of the Ritz method, where the trial function family is the displacement field associated with a finite element (8-node isoparametric quadrilaterals) representation of the section. A computer program was written where the cross section is discretized into 8-node quadrilateral subregions. Initially the program was verified using previously published results (both three-dimensional elasticity and technical beam theory) for pretwisted isotropic bars with an elliptical cross section. In addition, solid and thin-wall multi-cell NACA-0012 airfoil sections were analyzed to illustrate the pronounced effects that pretwist, initial twist axis location, and spar location has on coupled behavior. Currently, a series of advanced composite airfoils are being modeled in order to assess how the use of laminated composite materials interacts with pretwist to alter the coupling behavior of the blade. These studies will investigate the use of different ply angle orientations and the use of symmetric versus unsymmetric laminates. Author

N90-25058*# Montclair State Coll., Upper Montclair, NJ. Dept. of Psychology.

AN EMPIRICALLY DERIVED FIGURE OF MERIT FOR THE QUALITY OF OVERALL TASK PERFORMANCE c54

Moira LeMay *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship

Program 1989 Sep. 1989 p 111-113 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 05H

The need to develop an operationally relevant figure of merit for the quality of performance of a complex system such as an aircraft cockpit stems from a hypothesized dissociation between measures of performance and those of workload. Performance can be measured in terms of time, errors, or a combination of these. In most tasks performed by expert operators, errors are relatively rare and often corrected in time to avoid consequences. Moreover, perfect performance is seldom necessary to accomplish a particular task. Moreover, how well an expert performs a complex task consisting of a series of discrete cognitive tasks superimposed on a continuous task, such as flying an aircraft, does not depend on how well each discrete task is performed, but on their smooth sequencing. This makes the amount of time spent on each subtask of paramount importance in measuring overall performance, since smooth sequencing requires a minimum amount of time spent on each task. Quality consists in getting tasks done within a crucial time interval while maintaining acceptable continuous task performance. Thus, a figure of merit for overall quality of performance should be primarily a measure of time to perform discrete subtasks combined with a measure of basic vehicle control. Thus, the proposed figure of merit requires doing a task analysis on a series of performance, or runs, of a particular task, listing each discrete task and its associated time, and calculating the mean and standard deviation of these times, along with the mean and standard deviation of tracking error for the whole task. A set of simulator data on 30 runs of a landing task was obtained and a figure of merit will be calculated for each run. The figure of merit will be compared for voice and data link, so that the impact of this technology on total crew performance (not just communication performance) can be assessed. The effect of data link communication on other cockpit tasks will also be considered. Author

N90-25059*# Hampton Univ., VA. Dept. of Management.
A SYSTEMATIC APPROACH TO TRAINING: A TRAINING NEEDS ASSESSMENT **c53**
Margaret H. Manning *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 114-116 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 05I

In an effort to determine the gap between the actual performance and the necessary performance of employees for the effective and efficient accomplishment of an organization's mission and goals, an organization-wide Training Needs Assessment must be conducted. The purpose of this work was to conduct a training needs analysis and prepare a NASA Langley Catalog of On-Site Training programs. The work included developing a Training Needs Assessment Survey, implementing the survey, analyzing and researching the training needs, identifying the courses to meet the needs, and preparing and designing an On-Site Training Catalog. This needs analysis attempted to identify performance weaknesses and deficits; seek out and provide opportunities for improved performance; anticipate and avoid future problems; enhance and create new strengths. The end product is a user-friendly catalog of on-site training available. The results include: top-down approach to needs assessment; improved communication with training coordinators; 98 percent return rate of the Training Needs Assessment survey; complete, newly designed, user-friendly catalog; 167 catalog descriptions advertised; 82 new courses advertised; training logo; and request for the training application form. Author

N90-25060*# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.
MODELING GROWTH OF FATIGUE CRACKS WHICH ORIGINATE AT RIVET HOLES Abstract Only **c39**
Mark E. Mear *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 125-126 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20K

When a structural component is subjected to repeated stress cycles, it can fail at stresses which are well below the tensile strength of the material. The processes leading to this failure are termed fatigue. Instances of fatigue failure in aircraft have become an increasing concern. The crack leading to failure often originate at rivet holes and then grow in response to stress cycles which occur during the operation of the aircraft. A necessary step to preventing failures in todays fleet of aging aircraft is to increase the frequency and quality of inspections; steps were already taken in this direction. There is also a need for modeling of fatigue crack growth in the aircraft structures so that improvements in design can be established and predictions of the life of the components can be made. The purpose is to provide a method to accurately predict the growth of fatigue cracks and to use this method to make predictions about the life of aircraft structural components. The method relies on the formulation and numerical solution of a singular integral equation(s) for an arbitrarily shaped crack(s) which propagate in response to the applied loading. Of special interest to the aging aircraft studies are cracks which originate at circular holes (i.e., rivet holes), but other crack geometries can be treated equally as well. Author

N90-25061*# City Coll. of the City Univ. of New York, NY. Dept. of Mechanical Engineering.
ADVANCED SPACE TRANSPORTATION TECHNOLOGIES Abstract Only **c16**
Rishi S. Raj *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 129-130 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 22B

A wide range of propulsion technologies for space transportation are discussed in the literature. It is clear from the literature review that a single propulsion technology cannot satisfy the many mission needs in space. Many of the technologies tested, proposed, or in experimental stages relate to: chemical and nuclear fuel; radiative and corpuscular external energy source; tethers; cannons; and electromagnetic acceleration. The scope and limitation of these technologies is well tabulated in the literature. Prior experience has shown that an extensive amount of fuel needs to be carried along for the return mission. This requirement puts additional constraints on the lift off rocket technology and limits the payload capacity. Consider the possibility of refueling in space. If the return fuel supply is guaranteed, it will not only be possible to lift off more payload but also to provide security and safety of the mission. Exploration to deep space where solar sails and thermal effects fade would also be possible. Refueling would also facilitate travel on the planet of exploration. This aspect of space transportation prompts the present investigation. The particle emissions from the Sun's corona will be collected under three different conditions: in space closer to the Sun, in the Van Allen Belts; and on the Moon. It is proposed to convert the particle state into gaseous, liquid, or solid state and store it for refueling space vehicles. These facilities may be called space pump stations and the fuel collected as space fuel. Preliminary estimates of fuel collection at all three sites will be made. Future work will continue towards advancing the art of collection rate and design schemes for pumping stations. Author

N90-25062*# Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
FLEXURAL FATIGUE LIFE PREDICTION OF CLOSED HAT-SECTION USING MATERIALLY NONLINEAR AXIAL FATIGUE CHARACTERISTICS Abstract Only **c39**
Zia Razzaq *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 131-132 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20E

Straight or curved hat-section members are often used as

structural stiffeners in aircraft. For instance, they are employed as stiffeners for the dorsal skin as well as in the aerial refueling adjacent area structure in F-106 aircraft. The flanges of the hat-section are connected to the aircraft skin. Thus, the portion of the skin closing the hat-section interacts with the section itself when resisting the stresses due to service loads. The flexural fatigue life of such a closed section is estimated using materially nonlinear axial fatigue characteristics. It should be recognized that when a structural shape is subjected to bending, the fatigue life at the neutral axis is infinity since the normal stresses are zero at that location. Conversely, the fatigue life at the extreme fibers where the normal bending stresses are maximum can be expected to be finite. Thus, different fatigue life estimates can be visualized at various distances from the neural axis. The problem becomes compounded further when significant portions away from the neutral axis are stressed into plastic range. A theoretical analysis of the closed hat-section subjected to flexural cyclic loading is first conducted. The axial fatigue characteristics together with the related axial fatigue life formula and its inverted form given by Manson and Muralidharan are adopted for an aluminum alloy used in aircraft construction. A closed-form expression for predicting the flexural fatigue life is then derived for the closed hat-section including materially nonlinear action. A computer program is written to conduct a study of the variables such as the thicknesses of the hat-section and the skin, and the type of alloy used. The study has provided a fundamental understanding of the flexural fatigue life characteristics of a practical structural component used in aircraft when materially nonlinear action is present. Author

N90-25063*# College of Southern Georgia, Statesboro. Dept. of Mathematics and Computer Science.

AN INVESTIGATION OF A MATHEMATICAL MODEL OF AN OPTICALLY PUMPED Ti(3+):Al2O3 LASER SYSTEM Abstract Only **c36**

Lila F. Roberts *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 133-134 (For primary document see N90-25034 18-99)

Avail: NTIS HC A09/MF A02 CSCL 09B

During the last several years, solid state lasers were developed that have the potential for meeting rigorous performance requirements for space-based remote sensing of the atmosphere. In order to design a stable and efficient laser and to understand the effect on laser output of changes in the physical and design parameters, an understanding of the development of the dynamical processes of the laser is necessary. Typically, the dynamical processes in a laser system are investigated via rate equations describing the evolution of the occupancy in the electronic levels and of the photon density in the laser cavity. There are two approaches to this type of study. Most often, for the sake of simplicity, the spatial variations of the dynamic variables in the laser system are disregarded and the mathematical model consists of a system of first order nonlinear ordinary differential equations (ODE). The second approach is to take into account both spatial and temporal variations in the dynamic variables in the laser cavity. The resulting model consists of a first order semilinear system of partial differential equations (PDE). The model which was studied was studied was generic in the sense that it was a four-level laser system, but the parameters used in the numerical study were specific to Titanium-doped sapphire. For simplicity, a constant, spatially uniform pumping scheme was considered. In addition, a simplification of the model was made so that it treats a single lasing wavelength with a narrow bandwidth. The purpose was to investigate both versions of the mathematical model and to determine whether the numerical solutions are similar both qualitatively and quantitatively. The systems of ordinary differential equations were solved numerically using a Runge-Kutta-Fehlberg algorithm which was very efficient for typical values of the physical parameters. A numerical scheme, based on the Modified Euler method, for computing solutions to the system of partial differential equations was developed and implemented. The PDE model was solved numerically at the expense of greatly increased computer time. Author

N90-25064*# College of William and Mary, Williamsburg, VA. Dept. of Mathematics.

KHARITONOV'S THEOREM: GENERALIZATIONS AND ALGORITHMS Abstract Only **c34**

George Rublein *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 135-136 (For primary document see N90-25034 18-99)

Avail: NTIS HC A09/MF A02 CSCL 20D

In 1978, the Russian mathematician V. Kharitonov published a remarkably simple necessary and sufficient condition in order that a rectangular parallelpiped of polynomials be a stable set. Here, stable is taken to mean that the polynomials have no roots in the closed right-half of the complex plane. The possibility of generalizing this result was studied by numerous authors. A set, Q, of polynomials is given and a necessary and sufficient condition that the set be stable is sought. Perhaps the most general result is due to Barmish who takes for Q a polytope and proceeds to construct a complicated nonlinear function, H, of the points in Q. With the notion of stability which was adopted, Barmish asks that the boundary of the closed right-half plane be swept, that the set G is considered = to (j(omega)(bar) - infinity is less than omega is less than infinity) and for each j(omega)(sigma)G, require H(delta) is greater than 0. Barmish's scheme has the merit that it describes a true generalization of Kharitonov's theorem. On the other hand, even when Q is a polyhedron, the definition of H requires that one do an optimization over the entire set of vertices, and then a subsequent optimization over an auxiliary parameter. In the present work, only the case where Q is a polyhedron is considered and the standard definition of stability described, is used. There are straightforward generalizations of the method to the case of discrete stability or to cases where certain root positions are deemed desirable. The cases where Q is non-polyhedral are less certain as candidates for the method. Essentially, a method of geometric programming was applied to the problem of finding maximum and minimum angular displacements of points in the Nyquist locus (Q(j x omega)(bar) - infinity is less than omega is less than infinity). There is an obvious connection with the boundary sweeping requirement of Barmish. Author

N90-25065*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.

GENERATION OF CIRCUMFERENTIAL VELOCITY CONTOURS ASSOCIATED WITH PULSED POINT SUCTION ON A ROTATING DISK **c34**

Gregory V. Selby *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 137-140 (For primary document see N90-25034 18-99)

Avail: NTIS HC A09/MF A02 CSCL 04B

Numerous experimental studies were conducted on the steady, three-dimensional boundary layer over a disk rotating at constant angular speed in an otherwise undisturbed fluid. The subject flow geometry is of interest because it provides a relatively simple way to study the cross-flow instability phenomenon which occurs in three-dimensional boundary layers, as on swept wings. This flow instability results in the formation of a stationary spiral vortex flow field over the disk, as shown by Wilkinson and Malik. Using a hot-wire probe, the spatial wave pattern of stationary vortices, which filled the entire circumference of the disk was mapped. The subject flow instability caused transition-to-turbulent flow as the periphery of the disk was approached. The effect on receptivity and transition of discrete disturbance modes, such as three-dimensional toughness elements and acoustic excitation was investigated. The present study (an extension of the work of Wilkinson and Malik) is focused on the effect of pulsed point suction on flow instability and transition, and consequently, on the classical stationary vortical flow pattern. Author

N90-25066*# South Dakota School of Mines and Technology, Rapid City. Dept. of Mathematics and Computer Science.

CLOUD FIELD CLASSIFICATION BASED ON TEXTURAL FEATURES **c47**

Sailes Kumar Sengupta *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 141-145 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 20D

An essential component in global climate research is accurate cloud cover and type determination. Of the two approaches to texture-based classification (statistical and textural), only the former is effective in the classification of natural scenes such as land, ocean, and atmosphere. In the statistical approach that was adopted, parameters characterizing the stochastic properties of the spatial distribution of grey levels in an image are estimated and then used as features for cloud classification. Two types of textural measures were used. One is based on the distribution of the grey level difference vector (GLDV), and the other on a set of textural features derived from the MaxMin cooccurrence matrix (MMCM). The GLDV method looks at the difference D of grey levels at pixels separated by a horizontal distance d and computes several statistics based on this distribution. These are then used as features in subsequent classification. The MaxMin tectural features on the other hand are based on the MMCM, a matrix whose (I,J)th entry give the relative frequency of occurrences of the grey level pair (I,J) that are consecutive and thresholded local extremes separated by a given pixel distance d. Textural measures are then computed based on this matrix in much the same manner as is done in texture computation using the grey level cooccurrence matrix. The database consists of 37 cloud field scenes from LANDSAT imagery using a near IR visible channel. The classification algorithm used is the well known Stepwise Discriminant Analysis. The overall accuracy was estimated by the percentage or correct classifications in each case. It turns out that both types of classifiers, at their best combination of features, and at any given spatial resolution give approximately the same classification accuracy. A neural network based classifier with a feed forward architecture and a back propagation training algorithm is used to increase the classification accuracy, using these two classes of features. Preliminary results based on the GLDV textural features alone look promising. Author

N90-25067*# Florida Inst. of Tech., Melbourne. Dept. of Mechanical and Aerospace Engineering.
COMPUTATIONAL SIMULATION OF TRANSITION TO TURBULENCE THROUGH INVERSE MODELING Abstract Only **c34**
Paavo Sepri *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship program 1989 Sep. 1989 p 146-147 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 22B

The present investigation has focused on a computational methodology for the fundamental case of transition in channel flow, in which recently published experimental data are utilized both as a stimulus and as a measure of merit of the method. The research has proceeded along three avenues in parallel. The first task has consisted of the development and verification of a computer code which calculates the mean evolution of flow in a channel similar to the one employed experimentally by Blair and Anderson. An analytical test case was created for the dual purposes of code verification and of highlighting the interactions between the Reynolds stress and the mean velocity profile. This test case generated a Reynolds stress by the residue in the momentum equation which is produced by a typical analytical velocity profile. By a substitution of this Reynolds stress into the appropriate code module, the correctness of the code may be verified, along with the accuracy of the computational method. The second task pursued has involved the development of a triple layer model for the Reynolds stress profile, which was suggested and derived from experimental velocity profiles. It is demonstrated that the innermost length scale is based on the local friction velocity, the intermediate layer corresponds to the usual logarithmic law of the wall region in which the normalized Reynolds stress is approximately unity, and the outermost layer is represented by a closed mathematical form depending explicitly on the velocity profile in the wake region. The third task was comprised of scrutiny of the excellent databases developed by Blair and others, and the planning of its incorporation into the transition analysis. These extensive measurements indicate that turbulent statistics in the transition regime may be considered to alternate between laminar and fully turbulent types, the proportions of which are quantified by a measured intermittency function. Author

N90-25068*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
EXPANSION AND ORTHOGONALIZATION OF MEASURED MODES FOR STRUCTURE IDENTIFICATION **c18**
Suzanne Weaver Smith *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 148-149 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 11C

The purpose was to investigate a new simultaneous expansion/orthogonalization method in comparison with two previously published expansion methods and a widely used orthogonalization technique. Each expansion method uses data from an analytical model of the structure to complete the estimate of the mode shape vectors. Berman and Nagy used Guyan expansion in their work with improving analytical models. In this method, modes are expanded one at a time, producing a set not orthogonal with respect to the mass matrix. Baruch and Bar Itzhack's optimal orthogonalization procedure was used to subsequently adjust the expanded modes. A second expansion technique was presented by O'Callahan, Avitabile, and Reimer and separately by Kammer. Again, modes are expanded individually and orthogonalized after expansion with the same optimal technique as above. Finally, a simultaneous expansion/orthogonalization method was developed from the orthogonal Procrustes problem of computational mathematics. In this method modes are optimally expanded as a set and orthogonal with respect to the mass matrix as a result. Two demonstation problems were selected for the comparison of the methods described. The first problem is an 8 degree of freedom spring-mass problem first presented by Kabe. Several conditions were examined for expansion method including the presence of errors in the measured data and in the analysis models. As a second demonstration problem, data from tests of laboratory scale model truss structures was expanded for system identification. Tests with a complete structure produced a correlated analysis model and the stiffness and mass matrices. Tests of various damaged configurations produced measured data for 6 modes at 14 dof locations. Author

N90-25069*# Akron Univ., OH. Dept. of Polymer Engineering.
PROCESSING POLYMERIC POWDERS **c27**
James L. Throne *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 150-152 (For primary document see N90-25034 18-99)
Avail: NTIS HC A09/MF A02 CSCL 12A

The concept of uniformly and continuously depositing and sinter-fusing nominal 0.1 to 40 microns dimensioned electrostatically charged polymer powder particles onto essentially uniformly spread 5 to 20 micron grounded continuous fiber tow to produce a respoolable thermoplastic composite two-preg was formulated at NASA Langley. The process was reduced to practice under a NASA grant at the University of Akron this spring. The production of tow-preg is called phase 1. The production of ultrafine polymer powders from 5 to 10 percent (wt) polymer solids in solvent is considered. This is phase 0 and is discussed. The production of unitape from multi tow-pregs was also considered. This is phase 2 and is also discussed. And another approach to phase 1, also proposed last summer, was scoped. This is phase 1A and is also discussed. Author

N90-25070*# Old Dominion Univ., Norfolk, VA. Dept. of Engineering Management.

OPERATIONS AND SUPPORT COST MODELING USING MARKOV CHAINS Abstract Only **c65**

Resit Unal *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 153-154 (For primary document see N90-25034 18-99)

Avail: NTIS HC A09/MF A02 CSCL 09B

Systems for future missions will be selected with life cycle costs (LCC) as a primary evaluation criterion. This reflects the current realization that only systems which are considered affordable will be built in the future due to the national budget constaints. Such an environment calls for innovative cost modeling techniques which address all of the phases a space system goes through during its life cycle, namely: design and development, fabrication, operations and support; and retirement. A significant portion of the LCC for reusable systems are generated during the operations and support phase (OS). Typically, OS costs can account for 60 to 80 percent of the total LCC. Clearly, OS costs are wholly determined or at least strongly influenced by decisions made during the design and development phases of the project. As a result OS costs need to be considered and estimated early in the conceptual phase. To be effective, an OS cost estimating model needs to account for actual instead of ideal processes by associating cost elements with probabilities. One approach that may be suitable for OS cost modeling is the use of the Markov Chain Process. Markov chains are an important method of probabilistic analysis for operations research analysts but they are rarely used for life cycle cost analysis. This research effort evaluates the use of Markov Chains in LCC analysis by developing OS cost model for a hypothetical reusable space transportation vehicle (HSTV) and suggests further uses of the Markov Chain process as a design-aid tool. Author

N90-25071*# Duke Univ., Durham, NC. Dept. of Electrical Engineering.

MARS ROVER IMAGING SYSTEMS AND DIRECTIONAL FILTERING **c63**

Paul P. Wang *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1989 Sep. 1989 p 155-158 (For primary document see N90-25034 18-99)

Avail: NTIS HC A09/MF A02 CSCL 22B

Computer literature searches were carried out at Duke University and NASA Langley Research Center. The purpose is to enhance personal knowledge based on the technical problems of pattern recognition and image understanding which must be solved for the Mars Rover and Sample Return Mission. Intensive study effort of a large collection of relevant literature resulted in a compilation of all important documents in one place. Furthermore, the documents are being classified into: Mars Rover; computer vision (theory); imaging systems; pattern recognition methodologies; and other smart techniques (AI, neural networks, fuzzy logic, etc).

Author

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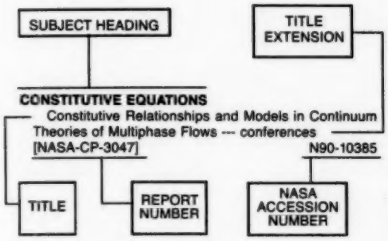

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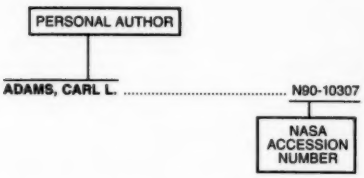

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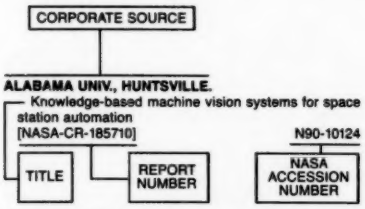

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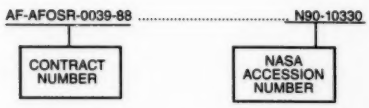

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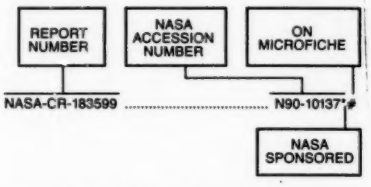

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CONF-9003164-1 ..... N90-24969 #
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DLR-MITT-89-18 ..... N90-24859* #

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EGG-M-89124 ..... N90-24880 #
EGG-M-89144 ..... N90-24387 #
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ICASE-90-42 ..... N90-24833* #
ICASE-90-43 ..... N90-24834* #

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IDA-D-736 ..... N90-24753 #

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The subject scope of *STAR* and *IAA* includes all aspects of aeronautics and space research and development, supporting basic and applied research, and applications. Aerospace aspects of earth resources, energy development, conservation, oceanography, environmental protection, urban transportation, and other topics of high national priority are also covered.

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STAR is categorized by 10 major subject divisions broken down further into 76 specific subject categories and one general division/category. The major subject divisions are listed on page ii in the Table of Contents, together with a note for each that defines its scope and provides any cross-references. For example:

AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics.*

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